Aviation Week
and Space Technology

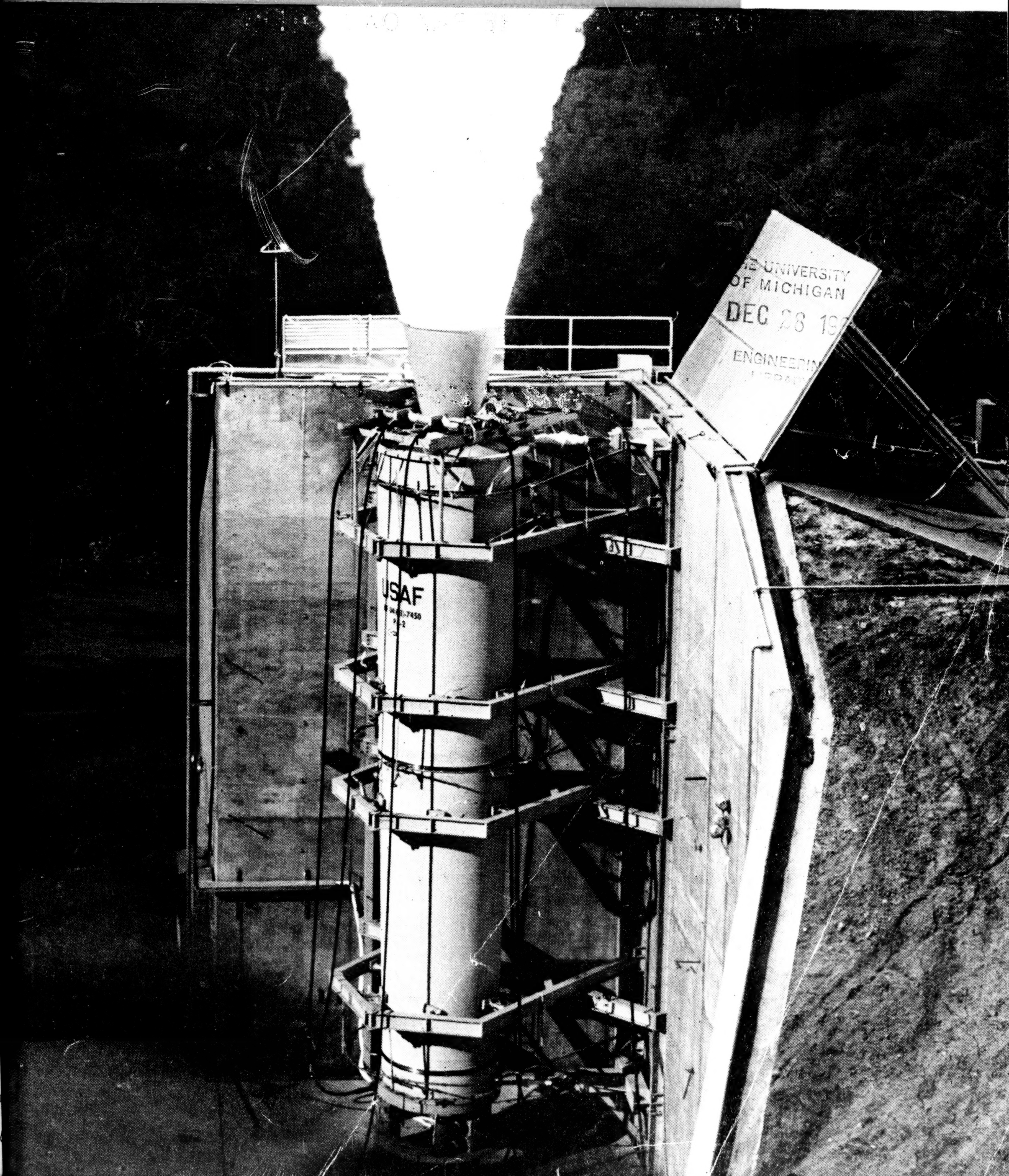
ents

A McGraw-Hill Publication

December 25, 1961

Sikorsky S-64 Designed As Prime Mover

United Technology Solid Rocket Motor Firing



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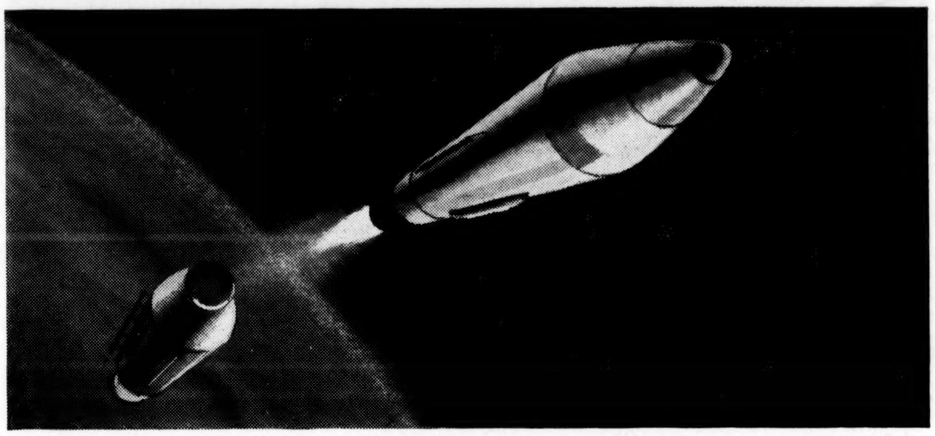

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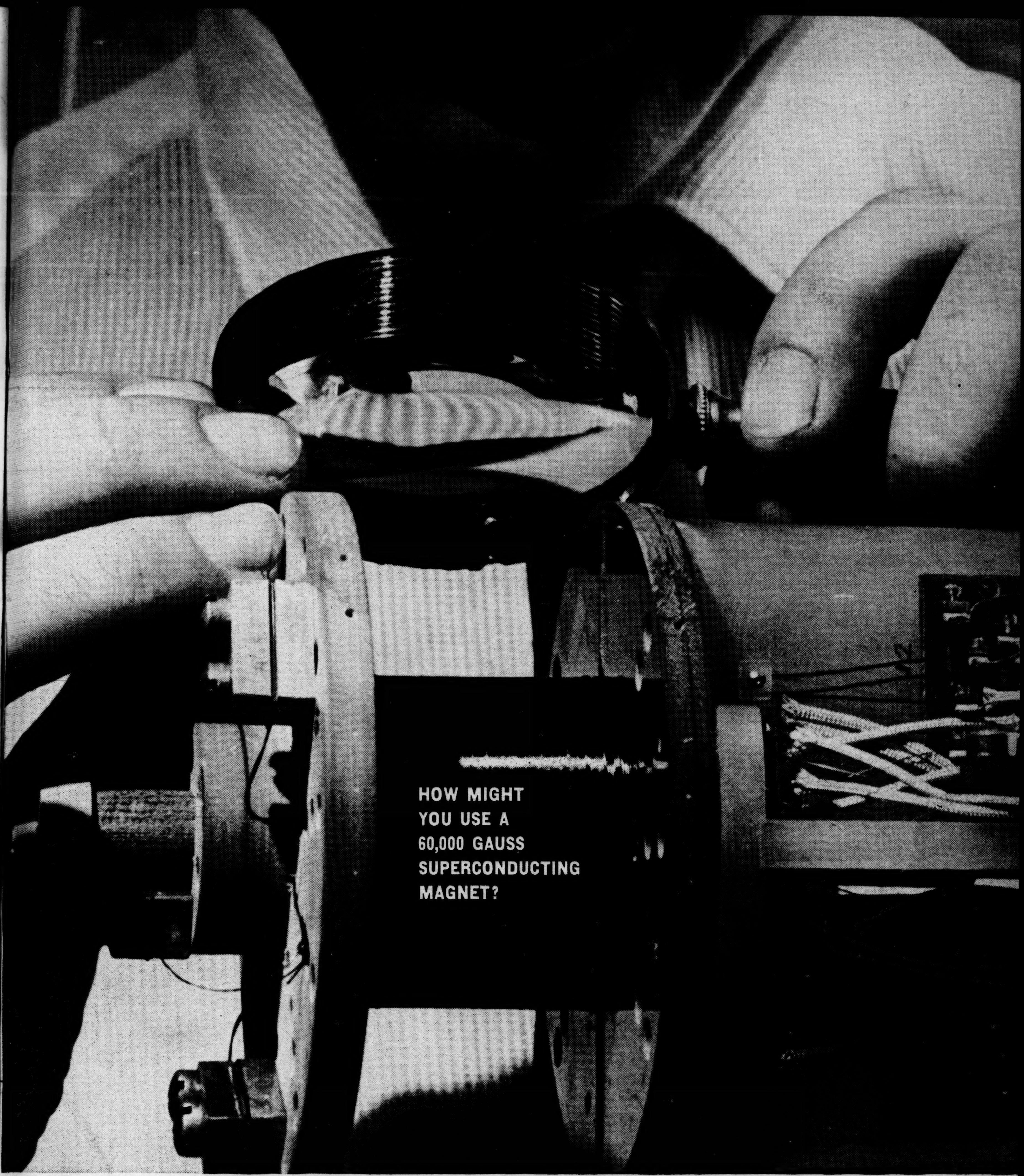

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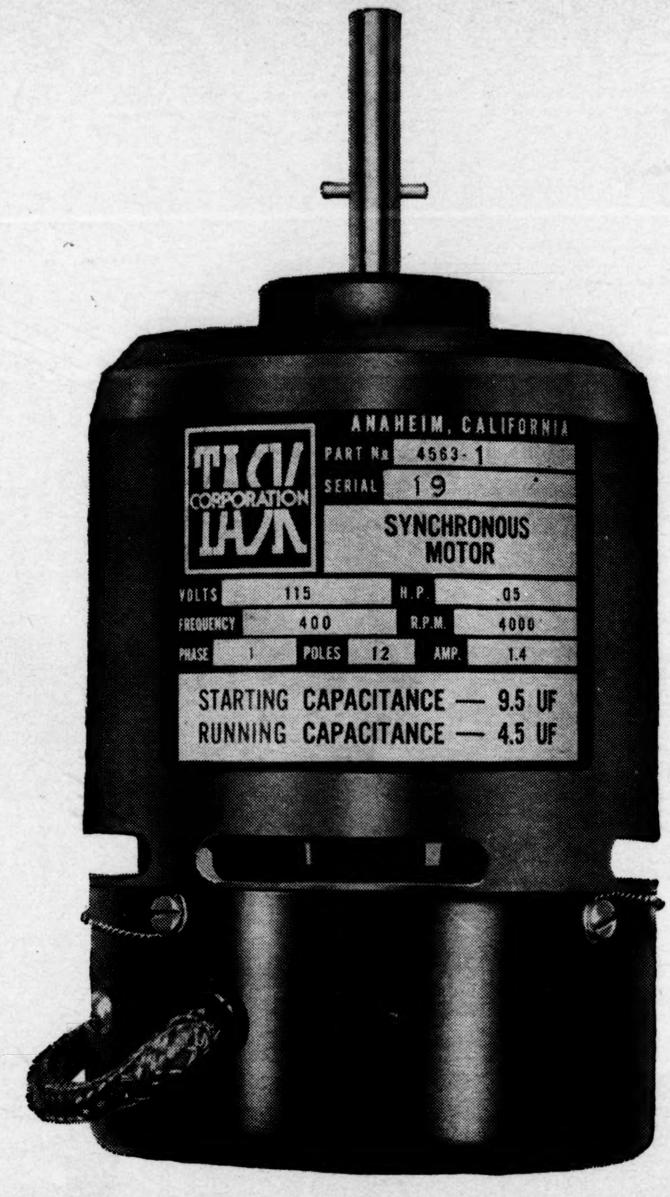

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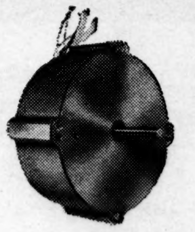

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Jan. 8-12—1962 Automotive Engineeri Congress and Exposition, Society of Aut motive Engineers, Cobo Hall, Detroit.

Jan. 9-11—Eighth National Symposium Reliability and Quality Control, Statl Hilton Hotel, Washington, D. C.

Jan. 15-17—Symposium on Optical Chara ter Recognition, Department of the Int rior Auditorium, Washington, D. Sponsored by Information Syste Branch/Office of Naval Research and R search Information Center/National B reau of Standards.

Jan. 16-18—Eighth Annual National Mee ing, American Astronautical Societ Sheraton-Park Hotel, Washington, D.

Jan. 21-24—Annual Meeting, Helicopt Assn. of America, Marriott Motor Hote Dallas, Tex.

Jan. 22-24—30th Annual Meeting, Inst tute of the Aerospace Sciences, Hotel A tor, New York, N. Y. Honors Nigh Dinner, Jan. 23.

Jan. 23-26—Third Annual Solid Propellan Rocket Conference, American Rock Society, Baylor University, Waco, Tex.

Jan. 24-26—Second Symposium on Therm physical Properties, Princeton, N. J. Spo sor: Heat Transfer Division, America Society of Mechanical Engineers.

Jan. 29-Feb. 2—American Institute of Ele trical Engineers' Winter General Meetin Hotel Statler and Coliseum, New Yor N. Y.

Feb. 6-7—Symposium on Redundancy Tec niques for Computing Systems, Depar

(*Continued on page 5*)

AVIATION WEEK and Space Technolog

December 25, 1961

Vol. 75, No. 26

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AEROSPACE CALENDAR

(Continued from page 4)

ment of the Interior Auditorium, Washington, D. C. Sponsor: Information Systems Branch, Office of Naval Research.

Feb. 7-9—Third Winter Convention on Military Electronics, IRE, Ambassador Hotel, Los Angeles.

Feb. 14-16—International Solid-State Circuits Conference, Institute of Radio Engineers, Sheraton Hotel and University of Pennsylvania, Philadelphia, Pa.

Feb. 19-21—Tracking & Command of Aerospace Vehicles, Institute of the Aerospace Sciences, San Francisco, Calif.

Feb. 27-Mar. 1—Third Annual Symposium on Nondestructive Testing of Aircraft and Missile Components (unclassified), Gunter Hotel, San Antonio, Tex. Sponsors: South Texas Section-Society for Nondestructive Testing; Southwest Research Institute.

Feb. 27-Mar. 1—Symposium on the Application of Switching Theory in Space Technology, Palo Alto, Calif. Sponsors: Lockheed Aircraft Corp.; Air Force Office of Scientific Research.

Mar. 1-3—Eighth Scintillation and Semiconductor Counter Symposium, IRE, Shoreham Hotel, Washington, D. C.

Mar. 5-8—Seventh Annual Gas Turbine Conference and Products Show, American Society of Mechanical Engineers, Shamrock Hilton Hotel, Houston, Tex.

Mar. 8-9—Institute of the Aerospace Sciences' Propulsion Meeting (classified), Cleveland, Ohio.

Mar. 14-16—Electric Propulsion Conference, American Rocket Society, Hotel Claremont, Berkeley, Calif.

Mar. 26-29—International Convention, Institute of Radio Engineers, Coliseum and Waldorf Astoria, New York.

Mar. 28-29—Third Symposium on Engineering Aspects of Magnetohydrodynamics, University of Rochester, Rochester, N. Y. Sponsors: American Institute of Electrical Engineers; Institute of the Aerospace Sciences; Institute of Radio Engineers; University of Rochester.

Apr. 1-4—Mid-Year Conference, Airport Operators Council, Shoreham Hotel, Washington, D. C.

Apr. 3-5—Launch Vehicles: Structures and Materials Conference, American Rocket Society, Ramada Inn, Phoenix, Ariz.

Apr. 3-6—National Aeronautic Meeting (including production forum), Society of Automotive Engineers, Hotel Commodore, New York, N. Y.

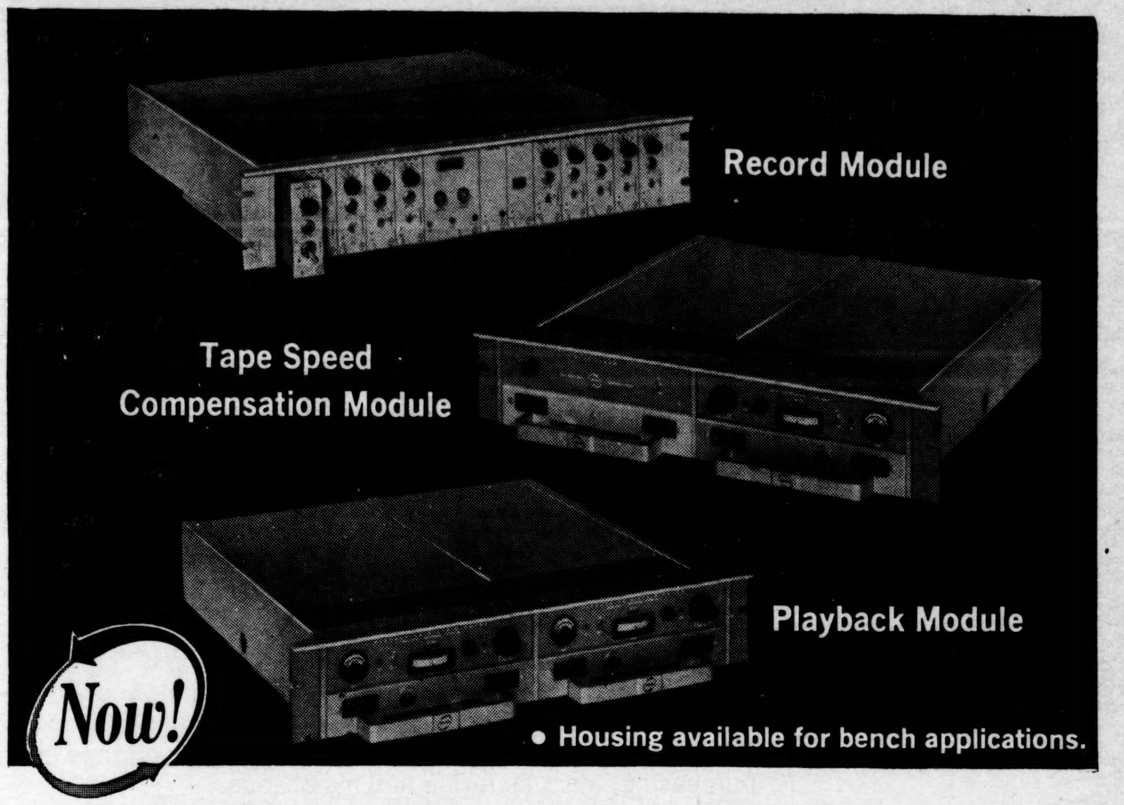
Apr. 10-12—Second Symposium on The Plasma Sheath—Its Effect Upon Re-entry Communication and Detection, New England Mutual Hall, Boston, Mass. Sponsor: AF Cambridge Research Laboratories.

Apr. 11-13—Southwestern Conference and Electronics Show, Institute of Radio Engineers, Rice Hotel, Houston, Tex.

Apr. 16-18—Second International Flight Test Instrumentation Symposium, College of Aeronautics, Cranfield, England.

Apr. 16-18—Aerospace Systems Reliability Symposium, Institute of the Aerospace Sciences, Salt Lake City, Utah.

Apr. 25-29—Western Space Age Industries and Engineering Exposition, Cow Palace, San Francisco, Calif.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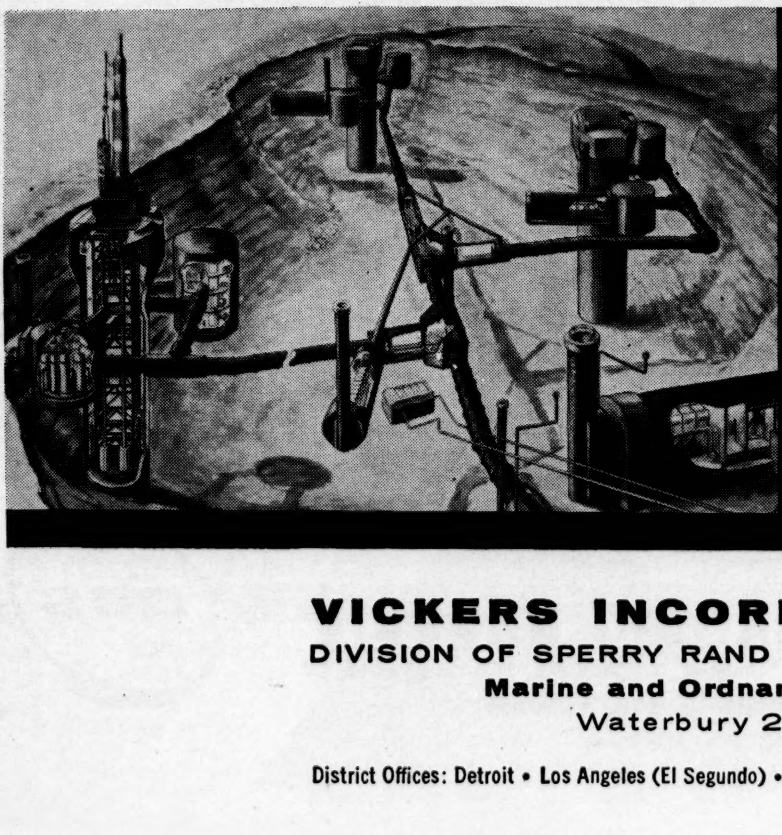

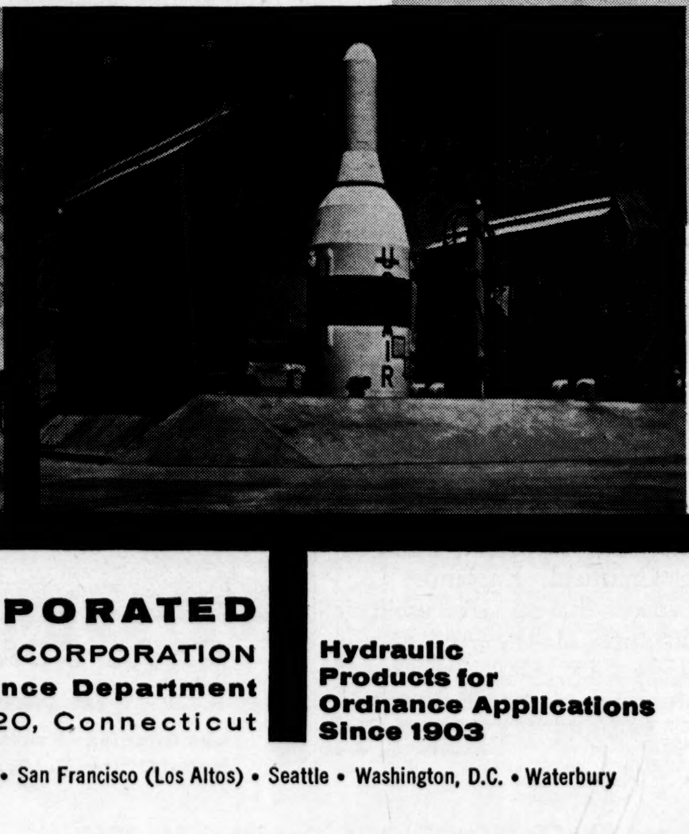

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COVER: Static firing of a flightweight prototype of a 96-in.-dia. conically segmented solid-propellant rocket motor by United Technology Corp. (AW Dec. 18, p. 30) produced a thrust of approximately 425,000 lb. for a burning time of about 81-sec. Mass ratio of the motor was slightly under 0.90 and the propellant load was approximately 132,000 lb.

PICTURE CREDITS

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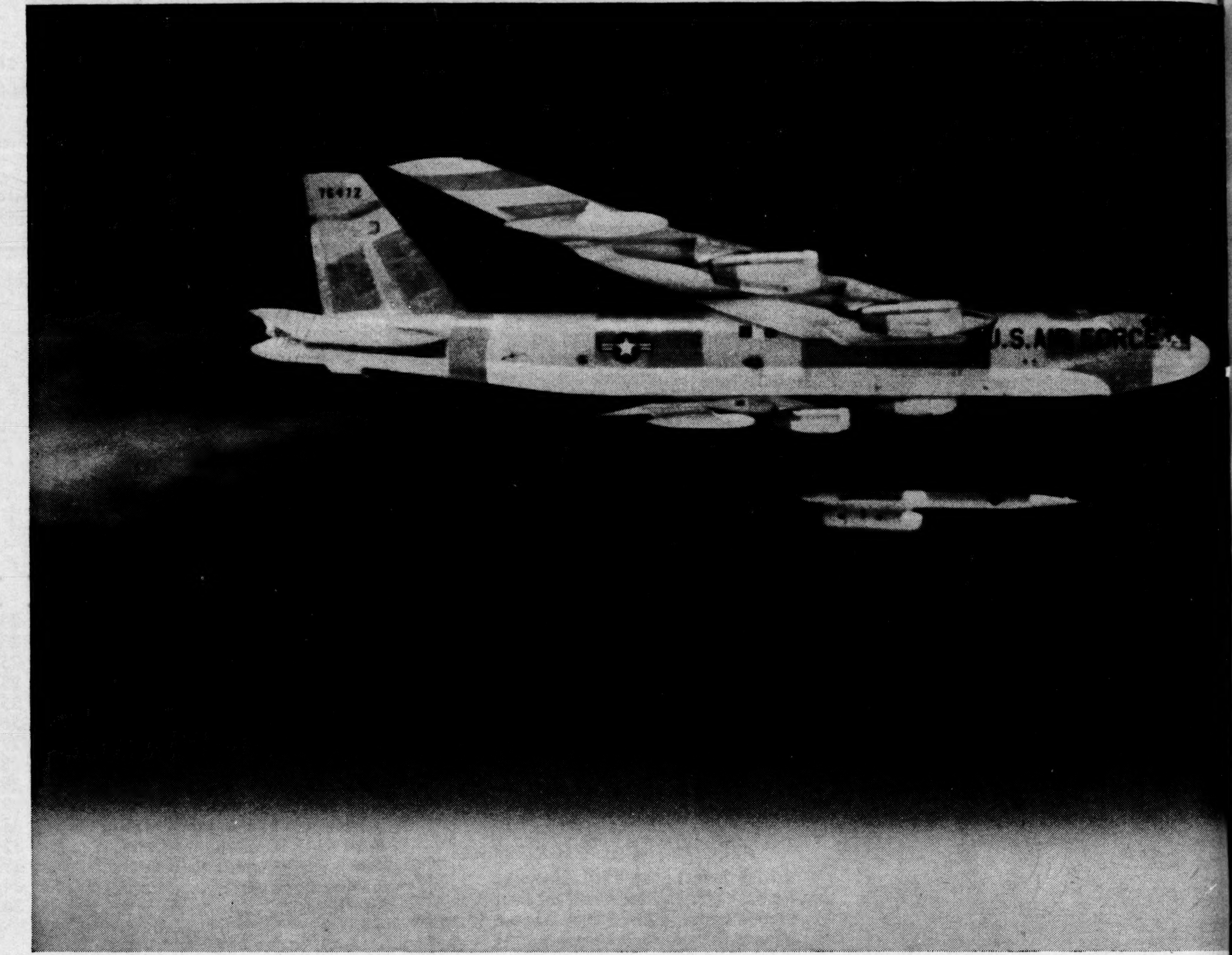
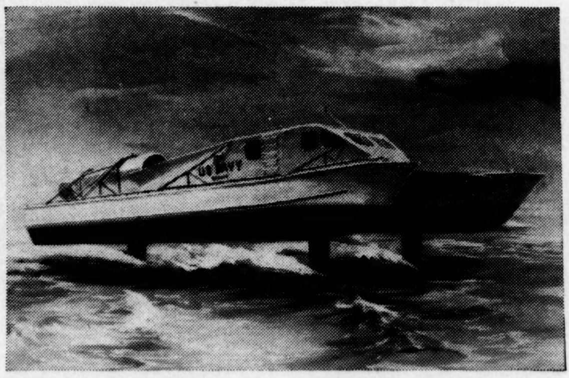


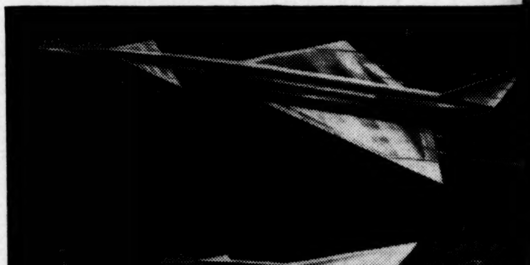
AERIAL MISSILE LAUNCHER. Photo shows Boeing B-52 missile bomber making in-flight launch of Hound Dog missile, which flies at supersonic speed toward target far ahead. In addition to missiles, versatile B-52s can carry regular bomb-bay load of gravity bombs. New B-52H, with turbofan engines and sophis cated electronics, is tailored for wide variety of Strategic Air Co mand mission requirements. Later, B-52H will carry hyperson Skybolt ballistic missiles, a 1000-mile weapon under developme

Capability has many faces at Boeing



JET HYDROFOIL. Drawing shows jet-powered twin-hull test hydrofoil Boeing is designing and building for U.S. Navy. Hydrofoil will "fly" on under-water wings at 115 mph.

TWIN-TURBINE helicopter, Boeing-Vertol 107, seats 25 and will enter service soon with New York Airways. 107s have been ordered for service in Japan, Canada and Sweden. Military version is being built for U.S. Marine Corps.



SUPERSONIC JETLINERS. Boeing co tinues to invest substantial sums in superson jet transport research. Drawing shows two Bo ing designs being studied. Supersonic jets wou fly two to three times speed of sound, make flig from New York to London in under three hou

BOEING

EDITORIAL

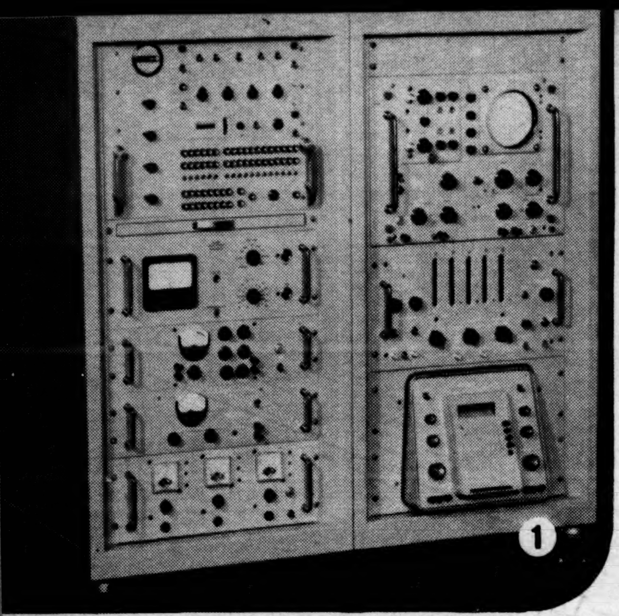
Laurels for 1961

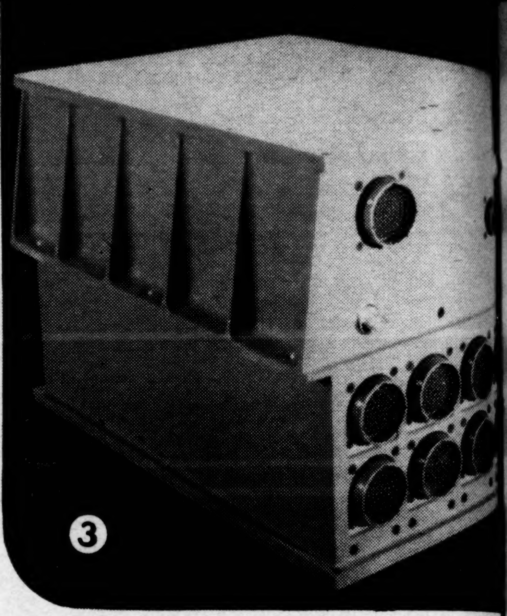
As we predicted at the end of 1960 (AW Dec. 26, p. 11), the pace of the U.S. aerospace effort has accelerated perceptibly during this year and there is considerable evidence all along the line (although still not enough to realize the full potential of our national resources) of more aggressive and determined leadership and a willingness to run the race with whoever wants to challenge. Hopefully this pace will continue to accelerate during 1962 and this country will be well on its way to widening its margin of technical superiority in fields where it has been maintained, and narrowing the gap in the long stern chase of the Soviets in space.

Here are the individuals and organizations that we think contributed efforts of major significance during 1961 in the aerospace field:

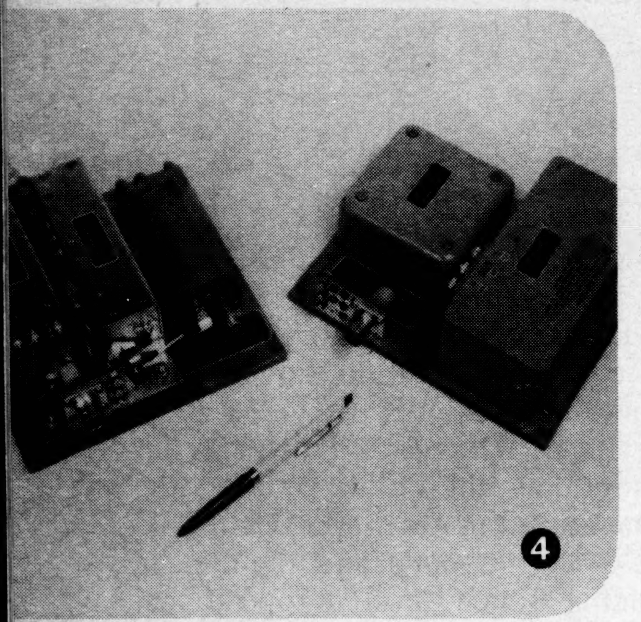
- **Vice President Lyndon B. Johnson** for his success in providing the U.S. space program with national priority and at last expressing this nation's determination to compete against all comers in space technology.
- **Alan Boyd**, Civil Aeronautics Board chairman, for his leadership in establishing direct contact between the CAB and airline presidents in an effort to solve the acute economic problems now besetting the air transport industry.
- **Mrs. Constance Wolf,** who at the age of 56 wrested the women's free ballooning endurance record from the Soviet Union with a 40 hr. 8 min. performance through a storm-tossed night.
- **Bob Turner,** vice president of Eastern Air Lines, for his work in reviving the fading airline art of passenger service and establishing the Boston-New York-Washington commuter shuttle service.
- **Personnel of the 6594th Recovery Control Group** of USAF Systems Command based at Hickam AFB, Hawaii, for their persistence in perfecting the aerial recovery technique for Discoverer space data capsules, resulting in four successful air snatches this year, of which three were in their new specially equipped Lockheed C-130B transports.
- **Edmund Converse,** Bonanza Air Lines president, for introducing a new concept of area excursion fares that will have significant economic impact on the local service airline business.
- **William T. Piper, Jr.,** for his octogenarian determination to push his company into support of private flying growth in the lower income brackets by producing the two-place Colt lightplane at a price well below normal profit margins in this field, and **Thomas F. Piper** who kept the project on the track through engineering into high volume production.
- **Dr. Edward Welsh,** executive secretary of the National Aeronautics and Space Council, for his administrative and political expertise applied to the numerous and vexing non-technical problems snagging the national space program, and for his indefatigable effort to achieve high priority for the program at the top level of government.
- **Drs. C. H. Townes** of Harvard, **A. L. Schawlow** and **Ali Javan,** of Bell Telephone Laboratories and **T. H. Maiman** of Hughes Research Laboratories for their work in optical masers (lasers), a fundamentally new type of device with important applications for space communications, guidance and exotic weapons.
- **Ben F. McLeod** of Pan American World Airways and **J. R. (Ray) Utterstrom** of Boeing Co. for spearheading both organizations' programs for increasing the utility of jet transports by increasing their all-weather operational capability.
- **Vice Adm. Robert Burns Pirie,** deputy chief of naval operations for air, for effective guidance of naval aviation into the era of Mach 2 carrier-based operations and increasingly sophisticated anti-submarine warfare work, and his unflagging and effective efforts to promote the cause of U.S. aviation in international circles.
- **Clotaire Wood,** of NASA, for his tremendously effective multi-lingual effort in establishing the U.S. space program scope and achievements among the people and technicians of Europe at the Paris Air Show.
- **Convair's** B-58 Mach 2 bomber for its persistent and effective penetrations of the U.S. air defense system, pointing the way toward a vital strategic delivery capability that is being critically neglected in the Defense Department.
- **Leslie Barnes,** president of Allegheny Airlines, for his success in broadening the economic base of local service carrier operations and pioneering accounting methods that will enable the separation of subsidy routes from those that are economically sound.
- **Barney Schmickrath** and **Dick Baseler** of Pratt & Whitney Aircraft for spearheading the effort to bring the JT3D turbofan into operational use with the Boeing 707 and the Douglas DC-8 jet transports and the Boeing B-52H bomber, providing a new level of operational economy and power for the gas turbine engine.
- **Jackie Cochran** for her continued dogged assault on world aeronautical records wherever she can find them—this year with her performance in the Northrop T-38 Talon supersonic trainer.
- **Bob Gilruth, Walt Williams** and **Max Faget** and their hard-working staff of the NASA Manned Spacecraft Flight Center for their courage and skill in carrying on the long stern chase of the Soviet Union's manned space flight achievements with Project Mercury.
- **Dr. Morris Tepper** of NASA and **Dr. Francis Reichelderfer** of the U.S. Weather Bureau for their leadership of the joint effort to develop an operational system for utilizing satellite-furnished weather information.
- **North American Aviation's Rocketdyne Division** for its successful firing of the F-1 single-chamber, million-pound-thrust rocket engine.
- **Wernher von Braun** and his Marshall Space Flight Center team for their persistence in pushing development of the Saturn space booster, powered by a cluster of eight Rocketdyne H-1 engines, to its first successful launch test at Cape Canaveral.
- **United Technology Corp.** and **Aerojet** for their successful firings of large solid rockets up to 500,000-lb. thrust, demonstrating the feasibility of the large solid concept.

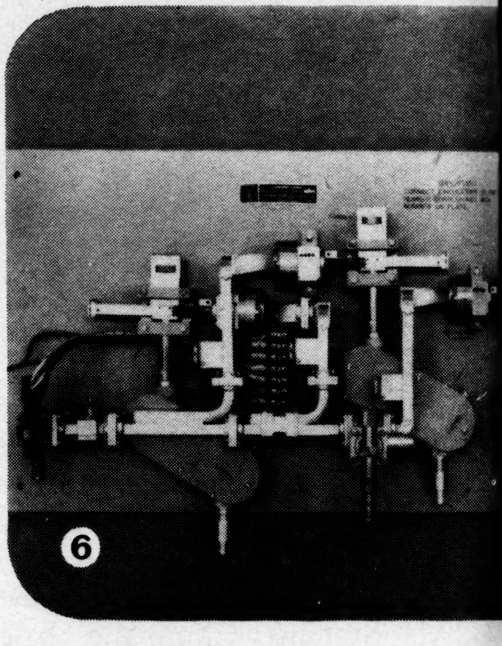
—Robert Hotz





HERE'S HOW TI SOLVES SPACE COMMAND/GUIDANCE PROBLEMS





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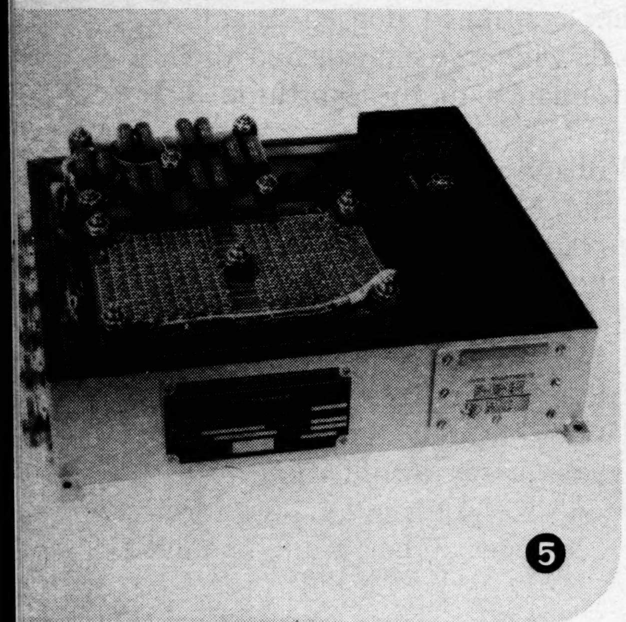
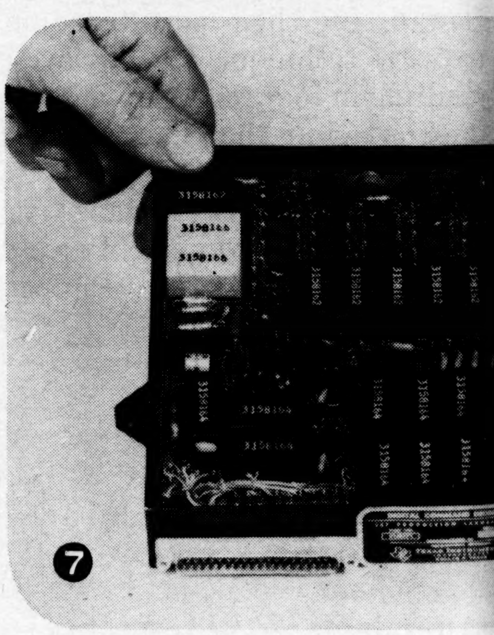
2. Solid-State FM/FM Telemetry Transmitters operated in Mercury spacecraft flights.
3. Flight Data Encoder uses high/low-level PCM telemetry system . . . with ±0.5% accuracy, nulled-out drift. A similar 70-channel system has been supplied to Jet Propulsion Laboratory for Mariner A.
4. Solid-State UHF Beacon Transponder made possible missile tracking by MIT Lincoln Laboratories Millstone radar.
5. Digital flight controller/programmer in Douglas Aircraft's Delta Launch vehicle helped orbit NASA weather satellites Tiros II and III, communication satellite Echo I, space probes Explorer X and XII.
6. 3-Channel Parametric Amplifier—Low-noise operation for C-Band monopulse satellite tracker for Bell Telephone Laboratories.
7. Digital Command Decoder for Ranger 3-5 lunar probes.





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WHO'S WHERE

In the Front Office

Gerald A. Hoyt, named general manager of General Electric's Light Military Electronics Department, Utica, N. Y. and **Herman F. Konig,** consultant to the vice president of GE's Defense Electronics Division, Syracuse, N. Y.

J. E. Schaefer has retired as vice chairman and a director of The Boeing Co., Seattle, Wash., and has been elected the company's first Director Emeritus. **J. E. Price,** vice president-administration and secretary, elected a director.

George Douglas, corporate vice president and general manager of the Radioplane Division, Northrop Corp., Beverly Hills, Calif., succeeding **M. W. Tuttle,** who will remain with Northrop as staff assistant to the president.

George S. Cushman, vice president-operations, Lockheed Propulsion Co., Redlands, Calif.

Pat (C. P. M.) Hunting, chairman of The Hunting Group of Companies, London, England, succeeding **Lindsay Hunting,** who will continue as a group director. **Clive (L. C.) Hunting** succeeds Pat Hunting as vice chairman.

Marvin R. Anderson, a vice president, Ex-Cell-O Corp., Detroit, Mich.

Ray Lull, vice president-manufacturing and engineering, Paul Hardeman, Inc., Los Angeles, Calif., and **Al Otjen,** vice president-engineering construction.

Arthur C. Omberg, a vice president, The Bendix Corp., Detroit, Mich., responsible for Bendix Mishawaka (Ind.), Bendix Products Aerospace (South Bend, Ind.) and Bendix Hamilton (Ohio) Divisions.

James J. Lamond, vice president-flight, American Airlines, Inc., succeeding **Capt. William B. Whitacre,** retiring.

William D. Roosevelt, vice president-operations, Air Associates, Inc., Teterboro, N. J., with offices in Wichita, Kan.

E. V. Huggins, executive vice president-international affairs, Westinghouse Electric Corp., Pittsburgh, Pa., and **George L. Wilcox** vice president and deputy to Executive Vice President **J. K. Hodnette.**

Dr. Theodore B. Focke, vice president-finance and administration, The Mitre Corp., Bedford, Mass.

Frank H. Williams, chief engineer and executive vice president, Wheeler Laboratories, Inc., Great Neck, N. Y., a subsidiary of Hazeltine Corp.

Dr. Arthur Roe, head of the Office of International Science Activities, National Science Foundation, Washington, D. C.

Honors and Elections

Ralph B. Lightfoot, chief engineer of Sikorsky Aircraft Division of United Aircraft Corp., Stratford, Conn., and **Igor A. Sikorsky,** chief aerodynamicist, have been elected fellows of the Royal Aeronautical Society of London, England.

Harrison Storms, president of North American Aviation's Space and Information Systems Division, has received the 1961 Pi Tau Sigma fraternity's Richards Memorial Award for outstanding achievements.

INDUSTRY OBSERVER

▶ Selection of a contractor to furnish the stellar-inertial guidance system (STINGS) for USAF's medium-range ballistic missile is expected in about six months. USAF has awarded study and development contracts to AC Spark Plug and General Precision. International Business Machines is developing a digital computer under subcontract to AC Spark Plug, and American Bosch Arma is working with General Precision. A different approach to the problem is being developed by United Aircraft Systems Center with funding from Defense Department's research and engineering office.

▶ **Project Advent, Defense Department's synchronous communications satellite program, has exceeded original cost estimates. Study is now under way to trim program costs to fit available funds.**

▶ South African and Australian governments have expressed interest in Breguet's NATO-sponsored anti-submarine warfare aircraft, the Atlantic (AW Nov. 27, p. 61). U. S. Navy also is interested but will make no decision until NATO testing has been completed. Export price on the aircraft is believed to be $3 million.

▶ **Project Big Shot, which calls for an ejection and inflation test of a rigid, 135-ft. passive communications sphere, is scheduled to be launched early next month from the Air Force Missile Test Center. Douglas Thor booster will send the package to 600-mi. altitude. Inflation sequence will be photographed and an attempt will be made to recover the film.**

▶ French navy has begun refitting a destroyer to receive complete Navy-General Dynamics Tartar anti-aircraft missile system. France is getting the first installation shipped abroad under the U. S. military assistance program. French navy is expected to buy at least three additional Tartar systems for its Surcouf type destroyers.

▶ **NASA's Jet Propulsion Laboratory is receiving a number of unsolicited proposals from industry suggesting new scientific experiments that could be conducted in additional hard-landing lunar capsules of the type Ford's Aeronutronic Division is making for Rangers 3 through 5. Possible delay in the Surveyor soft-landing program due to slippage in Atlas-Centaur vehicle development has prompted some to suggest use of the Aeronutronic capsule or another light, rugged payload, possibly boosted by a smaller vehicle, to demonstrate the soft-landing technique. One vehicle proposed for light-weight soft landings is the Titan 2 plus an Agena stage.**

▶ Bristol Siddeley is cutting metal for its BS.59 pure lift fan engine (AW Sept. 18, p. 43) at its Filton works. Engine will run early next summer. British government is sharing some of the research and development costs. One use will be for the Mark 2 VTOL Royal Air Force tactical transport.

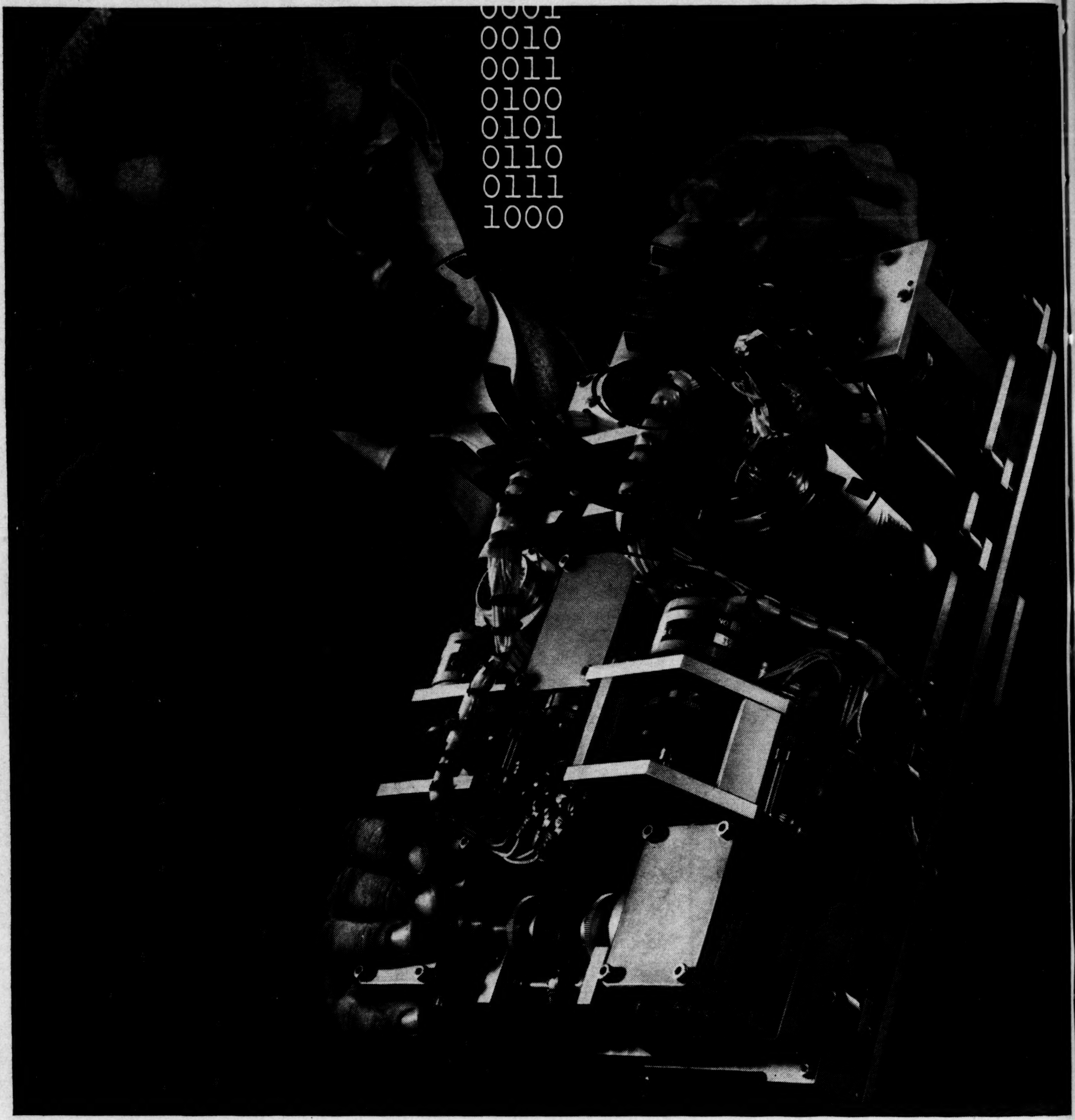
▶ **Russia is attempting to sell the VK-7 turbojet engine to India as an export item rather than under a license arrangement. Indian air force is evaluating two VK-7s at Bangalore for possible use in the Indian HF-24 fighter.**

▶ Second test model of the General Electric nose cone which will be launched from California to serve as a target for Army Nike Zeus anti-missile missiles launched from Pacific islands was tested aboard the last USAF-Martin Titan 1 research and development missile (AW Dec. 18, p. 34).

▶ **Bids for a regulator for a thermionic energy source delivering up to 600 watts for use with an Agena spacecraft are being submitted this month by industry to Lockheed Missiles and Space Co.**

▶ Results of research in magnetohydrodynamic accelerators has been applied by Allison Division of General Motors for welding and for spraying the throats of first-stage nozzles for the Minuteman missile.

▶ **Russia's Kiev Shipbuilding Yard has built an experimental catamaran on hydrofoils which is equipped with a 75-hp. engine and has a glass-reinforced plastic hull. It is intended for high-speed travel on shallow river waters.**



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Washington Roundup

Patent Storm Brews

The Administration has drafted a National Inventions Act that would establish sweeping new patent rights policies—all of which are vigorously opposed by the aerospace industry as well as other industries. The plan is to submit it to Congress next month. The proposed law was circulated among government agencies for comment last week by the Budget Bureau.

The act would require industry to share royalties with the government on all commercial licenses, require compulsory licensing after three years, with a limitation on the royalty fee; and give the government title to all patents unless the rights were waived by the head of the department involved.

Export-Import Bank's new policy of guaranteeing private financing against political risk is expected to open new markets for utility airplane sales to underdeveloped countries.

Final Budget Tussle

There were indications last week that Budget Bureau Director David E. Bell was still opposing the $2.5 billion increase in the proposed Fiscal 1963 defense budget (see page 14) over the $48.5 billion figure that he recommended. Whether his views will prevail over those of the Defense Department depends at least partly on international political developments between now and the time the Administration's budget request is presented to Congress, which must be done within 15 days after Congress reconvenes on Jan. 10. Bulk of the budget document, which runs to the size of a metropolitan telephone book, had gone to the printer by last week but some sections were being held open for last-minute changes. If the Administration should want to make further changes even after the document has been printed, it can do so in the form of altered priorities.

House Interstate and Foreign Commerce Committee, which was voted $150,000 more than three months ago to study noise abatement at airports, has yet to hire or assign a staff member to direct the investigation.

Black Lace Study

Ground effect machines equipped with helicopters or long-range weapons "may well have the greatest potential and the lowest operating costs" for anti-submarine warfare, according to a study known as Black Lace that was conducted for the U. S. Navy by Saunders-Roe Division of Britain's Westland Aircraft, Ltd. Main purpose of the study was to compare the operational potential of air cushion vehicles with existing and projected anti-submarine craft of other types. Saunders-Roe officials recently briefed Navy leaders, including Vice Adm. John T. Hayward, deputy chief of naval operations for development, on their findings.

Prospects are now brighter for Saunders-Roe to build an SRN.3 air cushion vehicle for the U. S. under mutual defense agreements. Negotiations have been off and on for some time. Saunders-Roe will test the SRN.2 next year (AW Dec. 11, p. 115).

Despite an acknowledged lead in rocket thrust, Soviet Russia has done comparatively little in the basic space sciences that will be the cornerstone of future space exploration, according to Dr. Robert Jastrow, director of National Aeronautics and Space Administration's Goddard Institute for Space Studies. Dr. Jastrow, who used the results of experiments in space as the theme for the Institute for Aerospace Sciences' 25th Wright Brothers Lecture, maintains that U. S. scientists have published five times as much on scientific space findings as their Soviet counterparts. He also says the U. S. must develop a large new group of scientists to make use of the vast amount of new data that advanced scientific satellites such as the Orbiting Astronomical Observatory are expected to produce.

Secrecy on Samos

Secrecy surrounding the Samos reconnaissance satellite program for the past few months is the result of a policy that has the backing of the President himself. It is so strict that it forbids the use of the word Samos by anyone remotely connected with the project. Nevertheless, the telephone book for headquarters of the deputy commander for aerospace systems of the Air Force Systems Command lists a Samos project office, with building, room numbers and telephones of key officials. The section of the Pentagon telephone book dealing with the Air Force lists "Director of the Samos Project," with a name, room number and telephone extension. Neither book bears any authorized security classification.

Federal Aviation Agency Administrator Najeeb Halaby said shortly after he took office last winter that Washington's $110 million Dulles International Airport terminal (see p. 28) was a "fingerless, hangarless, tenantless airport—a legacy we do not inherit with the greatest degree of glee and gratitude." Since then a three-man Halaby task force has studied the development plan. Last week Halaby said the airport "is going to be a great innovation, it is going to work, and it is going to generate new business for the carriers" despite landing fees that are expected to be more than double those now charged by Washington's National Airport.

—Washington Staff

Defense Budget Shifts Have Wide Effect

Tight central control by Secretary McNamara forces services and industry to adapt to altered process.

By Larry Booda

Washington—Tight central control exercised by the Secretary of Defense during the preparation of the Fiscal 1963 budget has profoundly affected military planning of weapon systems procurement. This in turn will make it necessary for industry to change its way of doing business with the Defense Department.

Major changes have been made in the budget formulation process but not in the form of the budget itself. The new ground rules are centered around the program package concept, in which forces that perform parts of similar missions are grouped together and their technical effectiveness balanced against their cost over a period of years.

Most radical shift is that final determination of the worth of a weapon system is almost always made at the Secretary of Defense level rather than by a military service.

Industry will have to take into consideration the following points in doing business with the services in the future:

- **Proposals on new weapon systems** will have to be prepared with the realization that the final decision will rest with Defense officials who have a broader perspective on the technical and cost effectiveness of the systems than a service would.
- **If there is doubt** about whether a system can be developed, the "if you will pay us we'll try it" approach will no longer be accepted.

Centralization of Authority

Defense Secretary Robert S. McNamara stepped into a partial vacuum in which one service's weapon system was pitted against another's weapon system for funds and decisions were reached as the result of compromises and political pressures.

This increased centralization of authority has decreased the inter-service competition for budget dollars. The strongest disagreements now are in the Office of the Secretary of Defense, where scientists and engineers are lined up against economists in greater degree than before because of their increased responsibilities in recommending decisions regarding the budget.

In place of the usual dollar ceilings, the services early this year were told to prepare program packages which would cover five or more years. When these were submitted last July, McNamara then ordered his staff to study them from the standpoint of cost effectiveness. These studies in turn produced guidelines for each service which were specific on dollar amounts and programs.

It is the intention of McNamara and Assistant Secretary of Defense (Comptroller) Charles J. Hitch that continuous program studies will take the place of the "crash" studies which marked the preparation of the Fiscal 1963 budget.

Offices in the services will gradually be reorganized to accommodate their work to the new system.

Focal point for programing above the service level is the office of Deputy Assistant Secretary of Defense Hugh McCullough. Reporting to him is the directorate of systems planning, headed by John W. Dixon, and the directorate of weapon systems analysis, headed by Alain Enthoven.

Zeus Funds Out

Washington—Defense Secretary Robert McNamara has overruled recommendations of Army and the Director of Defense Research and Engineering that $140 million in preproduction funds for Nike Zeus anti-ICBM missile be included in the Fiscal 1963 budget request (AW Dec. 18, p. 29). The action may be intended to enable the Administration to present a balanced budget, with the expectation that Congress will authorize additional funds for Zeus.

Meanwhile, Dr. Harold Brown, Director of Defense Research and Engineering, is attempting to get some of the Zeus preproduction funding reinstated.

The Administration can expect widespread political repercussions if it should withhold preproduction funds appropriated by Congress, an action taken by the Eisenhower Administration two years ago. Recently, the mayors of a number of Texas cities in the vicinity of Army's White Sands Proving Grounds wrote to President Kennedy, Secretary of Defense McNamara, their congressmen and senators, urging production for Zeus.

This is viewed as part of a campaign to arouse public pressure on the Administration. Pressure has been increased by recent successful Zeus tests and the fact that the program is running slightly ahead of schedule.

There is a continuous flow of program documents from this organization to the assistant secretaries of defense for civil defense, installations and logistics, international security affairs and manpower, and the director of defense research and engineering.

It is the last organization, headed by Dr. Harold Brown, that has had an increasingly powerful voice in the determination of the technical value of weapon systems now under development and those in the concept or research stages (AW June 26, p. 30). Its increase in importance is a direct result of the need for the Secretary of Defense to sift fact from the proprietary arguments used by the individual services to support their money requests.

Nevertheless, the weapon systems analysis and systems planning groups have double checks on Dr. Brown's recommendations. There are engineers among the economists in the analysis group. Use has been made of outside organizations such as the Weapons Systems Evaluation Group, the Air Force's Rand Corp., Navy's Operational Evaluation Group, and Army's Research Analysis Corp.

Personal Review

All of the recommendations resulting from this interchange have been personally reviewed by McNamara. He is following his personal management philosophy, which he has stated in part as follows: ". . . I think the role of the public manager is very similar to the role of the private manager; in each case he can . . . either act as a judge or a leader. In the former case he sits and waits until subordinates bring him problems for solution, or alternatives for choice. In the latter case he immerses himself in the operations of the business or the governmental activity, examines the problems, the objectives, the alternative courses of action, chooses among them and leads the organization to their accomplishment.

"I've always believed in and endeavored to follow the active leadership role. . . ."

The degree to which he has followed this line is evidenced by the number of what he calls his "projects" and others refer to as his "trombones," which have reached almost 200. The majority of these assignments or requests for information, which he sends to subordinates in his own office, the Joint Chiefs of Staff and the services,

Japanese Developed Anti-Tank Rockets Displayed

Anti-tank rockets developed by the Kawasaki Group for the Japanese Self-Defense Agency are displayed in a parade. The missile is wire-guided and has a range of approximately 5,000 ft. Called MAT, the missile was developed by Kawasaki Aircraft, Nippon Electric, Nippon Grease and Oil and Dai Nippon Celluloid. Missile was first fired last March.

deal with subjects which later will be analyzed by his staff before he makes decisions on the budget.

In October and November, when the Fiscal 1963 budget was in final preparation, McNamara sent proposed changes to the services for their comment. Since they were more than 600 in number, they were called "snowflakes."

Change in Approach

It is McNamara's participation in every detail that has caused some alarm among service officials and in his own immediate organization. If he were incapacitated, they ask, who would take his place? His activities are predicated upon personal ability to handle large amounts of paper work. They doubt whether a substitute or successor could perform the same way.

McNamara has substituted action on his part for action by the services. Guidelines for the Fiscal 1962 budget given the services by President Eisenhower said in part, "the . . . budget presents the ideal opportunity for each department and agency head to 'clean house' and to blue-pencil programs or activities where their experience indicates the wisdom of doing so."

Even though these words came from a previous administration, McNamara has followed their intent, regardless of opinions held by others, by cancelling two squadrons of the Titan intercontinental ballistic missile, limiting development of the B-70 supersonic bomber, cancelling the Eagle-Missileer antiaircraft system and deciding against use of extra funds voted by Congress for long-range bombers.

The Eisenhower 1962 defense budget was divided into "A," "B," "C" and "D" budgets. The "A" budget was to remain within the dollar ceiling of the Fiscal 1961 budget, and to be composed of the most urgent items. The "B" budget was to be 5% larger than the 1961 amount and include the next group of highest priority requirements. The "C" budget included another 5% made up of lower priority items and the "D" budget included all other items that the services thought the Secretary of Defense should consider.

Secretaries of defense preceding McNamara spent considerable effort on the budget, but they lacked a defense-wide integration tool such as the program packages.

$51 Billion Expected

As of last week, the total budget of the executive branch of the government was still being thrashed out between the Budget Bureau and the President. Involved were decisions on total amounts, reflecting political conditions and economic considerations. These could affect the $51 billion final figure expected to be requested for defense.

The defense budget has been evolving since World War 2. It has been broken down into functional categories: military personnel, operation and maintenance, procurement, research and development and military construction. Before World War 2, Army and Navy submitted different types of budgets based on different laws.

From hundreds of different accounts in the past the defense budget has been greatly simplified. It now has only 13 accounts each for the Army, Navy and Air Force. They are under six principal titles—Military Personnel, Operation and Maintenance, Procurement, Research, Development Test and Evaluation; Military Construction and Civil Defense.

The McNamara-Hitch team considered that the rapid technological pace of defense weapon systems required further relating of costs to weapon systems, tasks and missions, and further compression of time. Key to their solution is the application of weapon system effectiveness to cost. The cost must not only be known for the budget year but in general for the entire life of the weapon system, and specifically for a period of five years.

Three-Phase Process

Their approach to defense budgeting falls into three phases. The planning-requirements phase began last March when the Joint Chiefs of Staff, the secretary's office and the services were assigned specific projects dealing with the most critical requirement problems. These studies deal, for instance, with

Electronics Outlook

Success in the defense electronics business during 1962 will require more emphasis on effective management than on scientific advances, according to Stephen F. Keating, executive vice president of Minneapolis-Honeywell.

He cited these trends which are expected to result in far-reaching changes in the defense electronics industry: increasing difficulty in penetrating new markets; increased emphasis on value engineering; more government control over weapon system planning and development, and greater emphasis in procurement on contractor's ability to produce reliable equipment on time and at reasonable cost.

Changes in traditional government customers and channels of communication with them have resulted from defense department organizational changes, revised roles and missions, and emphasis on central service agencies and non-profit institutions, Keating noted.

Profits of aerospace companies, in terms of per cent of sales, fell from 3.8% in 1955 to 1.5% in 1959, while profit measured as a per cent of net worth dropped even more sharply, from 21.4% to 8%, he said.

In the past three years, he said, "the 41 companies that constitute the dominant force in the aerospace industry enjoyed an increase in gross sales from about $24 billion to around $26 billion, up some 8% while at the same time their profits fell from 3% to 2.5%, a decline of nearly 17%."

how many strategic bombers and missiles the U. S. will need during the next decade.

The studies were more than traditional military requirements studies. They were military-economic studies which compared alternative ways of accomplishing national security objectives. The planning-requirements phase has now become a year-round operation.

Formulation and review of programs, begun last May, was the next phase. General guidance was furnished to the military departments but no dollar ceilings were imposed. They were told to project their force levels to 1970, with specific costs through Fiscal 1967. This was the origin of the now-familiar program package.

A program package is an interrelated group of program elements that must be considered together because they support each other or are substitutes for each other. A program element is an integrated activity, or combination of men, equipment and installations whose effectiveness can be related to national security policy objectives. Examples are B-52 bombers wings, infantry battalions and combat ships.

The program packages as they now stand are the General War Offensive Forces, the General War Defensive Forces, the General Purpose Forces, the Sealift and Airlift, Reserve and National Guard Forces, Research and Development and Service-Wide Support.

The General War Offensive Forces package is divided into aircraft forces, land-based missile forces, sea-based missile forces, command, control, and communications forces, and headquarters and command support. The General War Defensive Forces include interceptor aircraft, surface-to-air missiles and the warning systems.

For fighting limited or local wars, there are the General Purpose Forces—artillery battalions, air defense units, combat ships and support vessels (except Polaris submarines), all Marine Corps units and Air Force units assigned to the Tactical Air Command and the theater commands.

Sealift and Airlift Forces embrace the Military Air Transportation Service and the Military Sea Transportation Service.

Reserve and National Guard Forces are not reviewed separately but as part of the defensive, general purpose and sealift and airlift packages.

All research and development projects not connected with program elements in other packages are in Package Six. Space projects are gathered under this category.

Catch-all Package

Service-Wide Support is the catch-all package, including recruit, technical, and professional training; overhead of supply and maintenance systems, medical support, intelligence, and higher headquarters.

While these programs were being reviewed last summer, President Kennedy asked Congress for $3.5 billion in additional programs, mostly for General Purpose Forces. Changes were required in all packages to some extent, however.

After these changes were made, McNamara made his tentative decisions for Fiscal 1963 and on Sept. 22 he forwarded them to the services. What each of the services in previous years had taken five months to prepare was condensed this year into the period from Sept. 22 to Oct. 23. Their submissions were made in the standard category form rather than as program packages.

The third and last phase of the budgeting process was completed early this month, when the defense budget went to the Budget Bureau for inclusion in the over-all executive budget request. During that final period, the category submissions were reconverted into package form for aid in making decisions, and change memoranda—the "snowflakes" mentioned earlier—were sent to the services for comment. These comments were considered in making final defense budget decisions. There als were continuous cross-discussions with the President and his Budget Bureau.

McNamara and Hitch are not ye satisfied with the budgeting process They would like to see better data submitted with requests. They decry pr sentations which are slanted toward th interests of an individual service, an are demanding consideration of th over-all defense need.

They want uniformity in service submissions. This should be accomplishe in the preparation of the Fiscal 196 budget. They want actual analyses o weapon system effectiveness—not just description.

More formal procedures will be designed to allow prompt changes in th packages to meet changes in the international situation.

Decisions have yet to be made o just what the character of the Genera Purpose Forces and Service-Wide Support should be. The offensive and defensive forces are fairly well identifie at this point.

In order to meet the problem of th amount of time McNamara spends o his reviews, the time periods involve in the Fiscal 1964 budget process wi be extended. This is the reason for th year-round programing procedure.

Continuous programing involves submission of progress reports, progra changes and program updating to th assistant secretary of defense (comptroller), who in turn coordinates them with other elements of the secretary' office and the secretary himself.

The secretary in turn must coordinat his decisions with other departmen and agencies and the Joint Chiefs o Staff.

Monkey Pod Is Lost After Atlas E Flight

Washington—Passenger pod containing a 4-lb. Rhesus monkey was los about 1,000 mi. off Ascension Islan Dec. 19 after a successful flight on a Atlas E launch vehicle.

The restrained monkey was the firs to be flown with physiologic sensors implanted in its body. Although the mission was the first in which the Ai Force was permitted to confirm a primate payload before launch, USA would not release flight objectives o stresses the monkey encountered.

Inability to recover the pod wa caused by failure of the homing beacon shortly after the pod impacted.

Also on board the vehicle was neutron density sensor, consisting o four sets of boron triflouride detectors designed to measure neutron in relation to altitude. They were to recor data primarily within the lower Va Allen radiation belt, at 70-600 mi.

Boeing Co. Will Build Saturn S-1B Stage

Washington—Boeing Co. has been selected to develop, build, test and launch the Saturn S-1B booster stage, but the National Aeronautics and Space Administration has not decided whether the vehicle will be powered by four or five engines.

The S-1B will be used to boost the three-stage Saturn C-4 vehicle which will carry the three-man Apollo spacecraft on circumlunar missions, and be the rendezvous launch vehicle in Apollo lunar landing missions. As described by AVIATION WEEK (Dec. 18, p. 27), the S-2 second stage will be powered by a cluster of Rocketdyne hydrogen-oxygen J-2 engines, and the third stage will consist of a single J-2.

Douglas Aircraft Co. was awarded a contract Dec. 20 by NASA to develop, build and test six third-stage vehicles, which are designated S-4B. Contract value for the Douglas work is $50 million, and includes four static test vehicles.

The Boeing contract, now being negotiated, will exceed $300 million. It calls for 24 flight boosters, and two to four ground test vehicles.

First for Boeing

The S-1B contract was the first NASA hardware contract Boeing has won, and it is the largest launch vehicle contract the agency has awarded. The Boeing proposal named its top management echelon, and listed Rocketdyne to assist in the static test phase.

Rocketdyne also builds the 1.5 million lb. thrust F-1 engine which will power the S-1B stage. NASA expects to decide within three months whether the engine cluster for the stage will be four or five barrels, but said withholding the decision will not delay stage production.

The S-1B production schedule is being keyed to completion of static test facilities at Pearl River, Miss., which is expected sometime in 1964. NASA said both four and five-engine configurations can fit into the same spaceframe, and the decision on which to build will be based on whether an engine-out capability is required.

The cluster will be 33 ft. in diameter, 70-80 ft. high and weigh 5 million lb. Both J-2 upper stages will be 18.5 ft. in diameter and 75 ft. high.

George H. Stoner was appointed general manager of Saturn boosters for Boeing with his office at Michoud. Stoner led the Boeing group in the S1-B competition (AW Sept. 4, p. 24). General manager of the Boeing Michoud Branch will be Richard H. Nelson.

Stoner had been manager of the Boeing Dyna-Soar program, and Nelson was manufacturing manager-electronics of the company's Aero-Space Division at Seattle, Wash.

Other branch directors are Clinton A. Wilkinson, engineering; Robert C. Dunigan, booster test; F. L. Coenen, operations; Clarence M. Riley, quality and reliability assurance; S. H. Stein, Wichita booster section; Gene B. Larson, program planning and control; Robert A. Trigg, facilities; Albert A. Larsen, industrial relations; Einar Larson, finance, and Wallace H. Judd, contract administration. All but Stein will be transferred from Seattle to the new Michoud plant.

S-1B Personnel

Boeing eventually will have 5,000 engineers and production personnel on the S-1B project, most of them at Michoud. Other branches will be at the Pearl River test site, the Atlantic Missile Range, Seattle and Wichita, Kan.

Several key staff members will be assigned soon after the first of the year to the George C. Marshall Space Flight Center on temporary assignment for familiarization, training and liaison with NASA S-1B managers.

North American Aviation's Space and Information Systems Division, which won the contract for the Apollo spacecraft, is developing the S-2 second stage under a contract awarded in September. Although this stage was configured with four J-2 engines at the time of the contract announcement, it may consist of five or six barrels if the booster stage contains five F-1 engines.

Boeing will share the Michoud production facility with Chrysler Corp., which won the contract to build the S-1 booster stage; with a third contractor who will build the RIFT nuclear test rocket stage, and with the Mason-Rust Co., which was awarded the housekeeping contract for the facility (AW Dec. 18, p. 33).

Eleven New Orleans contractors last week protested selection of an outside firm to provide housekeeping services at the plant, but James E. Webb, NASA administrator, said criteria for the selection were made before proposals were received. "Fairness and legality," Webb said, "require that we now decline to reopen the matter."

Mason-Rust is a combination of two companies, one from Pittsburgh, Pa., and the other from Lexington, Ky.

Meanwhile, NASA reported that the last of the S-1 booster tanks has been built at the Marshall Center, and all tank production will now shift to the Chance Vought Corp. in Dallas. NASA built tanks for the first four flight boosters. The tail section, spider beam assembly and instrument compartments will continue to be built at Marshall.

Dyna-Soar Suborbital Flights Eliminated

Washington—USAF-Boeing Dyna-Soar boost glider program is undergoing another major reorientation that will eliminate all suborbital flights and produce an orbital flight two years earlier than the previous timetable.

Funding for Fiscal 1962 remains unchanged at $100 million. Defense Department has refused to spend the extra $85.8 million voted by Congress for Fiscal 1962 to accelerate the program. Funding for Fiscal 1963 is expected to exceed $100 million.

USAF is cancelling its $20.8 million contract with Martin-Marietta Co. for Titan 2 boosters for the suborbital flights. Of this, $14.7 million has been spent. It also is cancelling a $1.5 million contract with Aerojet for rocket engines, of which $800,000 has been spent.

Orbital flights will use the Titan 3 booster (AW Dec. 11, p. 25). Dropping the suborbital flights eliminates the need for several Atlantic Missile Range landing sites and a number of gliders, and requires reorienting the orbital flights to gain data on the hypersonic flight regime during re-entry, instead of during escape. USAF expects to gain two to three times the information it would have with the suborbital flights.

At least two and possibly as many as four unmanned orbital flights will precede a piloted flight. The orbital glider plus solid propellant escape rocket will weigh approximately 15,000 lb. Rocket will be jettisoned before the glider goes into orbit.

Program is still considered strictly a research and development project by the Defense Department. USAF still hopes Dyna-Soar will develop into a weapon system. Titan 3 is capable of boosting proposed weapon system versions of the glider, including an on-board propulsion system, for the majority of the proposed missions.

Program would have moved even faster if the $85.8 million and the Saturn C-1 booster had been used. USAF's objections to using a booster that operates on cryogenic fuels helped rule out the Saturn.

Harry Goldie succeeds George H. Stoner as Dyna-Soar chief at Boeing. Stoner has been named general manager for Saturn boosters (see story).

USAF Plans Lunar Shelter Design Study

By Irving Stone

Los Angeles—Design concepts and requirements for a prefabricated, erectable lunar structure for availability by Fiscal 1967 to afford relatively unsophisticated, basic protection for six men for one month will evolve from a nine-month study to be completed for the Ai Force by the end of 1962.

Proposals for this study from industry competitors to Air Force Systems Command's Aeronautical Systems Division are due this week and a contract award is expected by April.

This rough-and-ready but adequate approach to lunar housing contrasts with the intention of National Aeronautics and Space Administration to initially use a module of the Apollo spacecraft for sheltering astronauts. Air Force probably also has considered using a landed spacecraft for this purpose but anticipates the need for an additional, temporary shelter as a safety hedge for first astronauts.

Indicative of Air Force's independent thinking for establishment of lunar installations and for exploration, the projected study will complement another for a manned roving moon vehicle (AW Dec. 18, p. 56), scheduled for readiness in 1966, and for which bids have been submitted. This roving lunar vehicle would be landed on the moon before the shelter and incorporate provisions to be manned. Indications are that both these efforts will complement a manned lunar base expected to be established in the 1970 time period.

Weight limitations on the transportation of structural materials such as concrete and steel and the hazardous, unsuitable environment in which to erect a structure using this type of material eliminate the permanent type of shelter at the present time.

Shelter Philosophy

Air Force bases its preliminary shelter lunar philosophy on the now-accepted premise that current missile and space emphasis indicates successful moon landings within the next 5-10 year period. Designing a shelter to meet the harsh lunar environment will involve a pyramid of problems—protection against vacuum, space radiation, meteoroids, temperature extremes and, of at least equal importance, the ability of astronauts to erect any kind of adequate shelter on the moon in a minimum period of time. Reliability of the shelter would be increased if the first men on the moon were not required to assemble the structure—actually being required to do little, if anything, to have a life-support shelter after arrival on the moon. It is against this background that the projected study will be made.

Feasibility of a lunar shelter is not an unknown quantity to Air Force planners. It has been studied by industry in response to SR 183 (AW Apr. 27, 1959, p. 26) for a lunar observatory, SR 192 (AW Sept. 28, 1959, p. 26) for a lunar strategic system, and the follow-on SR 17532 for a permanent lunar base and logistics technique.

Although knowledge of lunar environment is considerably incomplete, sufficient data is available to justify the projection of a preliminary lunar shelter. In view of the accelerated pace of space exploration, shelter concepts which can be evaluated and adapted in a minimum period of time will have to be utilized.

The shelter envisioned in the forthcoming study would be prefabricated and prechecked on earth, then launched, packaged, for letdown on the moon. Astronauts who landed subsequently might be required to erect the shelter, would check its worthiness from the spaceship or from within the shelter, whichever is more feasible, and cover the shelter for environmental protection.

Study's Objectives

Prime objectives of the study effort will include:

- **Preliminary design concept.** This will apply to the preconstructed shelter, including concepts for components used in the structure, as well as isometric, dimensioned drawings to delineate the design. While the study contractor will be expected to establish all essential design details, Air Force has specified some basic requirements for the shelter.

Polaris Fuel Shift

Range of Navy's Polaris A-3 missile will fall several hundred miles short of its projected 2,500 naut. mi. goal as a result of recent decision to use cooler-burning propellant in the missile's first stage.

Propellant with burning temperature of about 6,000F was selected to sidestep problems which the first stage development contractor, Aerojet-General, was encountering with the original 6,600F. propellant (AW Sept. 4, p. 31). Aerojet also is investigating downstream swivel nozzles for the A-3 first stage thrust vector control.

In related A-3 activity, Navy has canceled contract with Hercules-Allegany Ballistic Laboratories to build 10 first stage A-3 motors because ABL is too busy to handle this job in addition to second stage Polaris A-3 production.

The structural design of the shelter will be required to include materials able to resist the harsh environment of the moon without deterioration to create an unsafe condition.

Personnel safety will be a prime factor, overriding any design and economy considerations.

The shelter will be required to support personnel without the need for wearing space suits or other types of protective clothing, indicating a "shirt sleeve" environment. Work outside the shelter will be performed, with space suits, only under emergency conditions. Otherwise, personnel will be outside the shelter only in protective capsules of roving lunar vehicles.

Emergency measures will be incorporated in the shelter to provide against effect of punctures and failure of oxygen or other life support systems, thus necessarily requiring analysis for prevention of rapid decompression, maintenance of thermal equilibrium and shielding against radiation effects.

Entrance and exit facilities for the shelter will require analysis of air locks, and time required for establishment of pressurized environment in the air lock after use also will have to be firmly established.

In addition to satisfying physical needs of the astronauts, psychological needs also will have to be considered, Air Force has specified.

Shelter Interior

Interior of the shelter will be divided into specific areas for work, sleeping, eating and other functions required for existence and to support activities outside the shelter.

Instrumentation will be included in the shelter to permit checkout of its systems from the spaceship. An analysis will be made of applied research which will be required for shelter checkout remotely from earth, and for remote control from earth, if this is desirable, of the lunar roving vehicle to cover the shelter with lunar "rubble."

Power supply system will be analyzed to determine the type of power source and electrical load necessary to support all functions within the shelter. The power supply will be designed as an integral part of the shelter to meet the one-shot readiness capability for the shelter system—everything delivered in a single launch. After landing on the moon, it might be desirable to separate the power supply from the shelter proper, connecting the two by cable.

Cargo envelope to accommodate the packaged shelter and its equipment tentatively is seen as 35 ft. long x 13 ft. in diameter with a weight capacity limit of

20,000 lb. Method of lunar letdown for the shelter package and positioning on the moon's surface will have to be detailed.

- **Applied research plan.** This will be required, in detail, to outline the research experiments and other efforts necessary for the shelter to be available by the middle of Fiscal 1967, and to specify the funding and man-years for these particular experiments and for the over-all program.

The applied research plan also will define problem areas and solution approaches with respect to bearings, lubricants, seals, connections and joints, material fatigue resulting from pressure cycling, blasting and soil-covering, and vacuum effects such as welding, sublimination and evaporation. Applicable toxicology also will have to be anticipated.

Basic assumptions made to guide the concept for the lunar shelter design include:

- **Moonquake effects** will not be critical.
- **Lunar surface material** will not be a radiological hazard.
- **Lunar dust or rubble** will be as much as six inches deep at the shelter site, which will be approximately flat.
- **Shelter will be landed** on the moon during the lunar night to minimize danger from solar flare radiation and will have to be covered within 24 hr.
- **Shelter will require** at least six feet of lunar surface material cover for minimum protection from solar radiation and meteoroids. This lunar material will be decked over the shelter, with the aid of manipulating devices of previously landed roving lunar vehicle. An alternate scheme would be to have the shelter material afford an equivalent protection.

Computer Growth

Washington—More than 5,000 computers are in operation today, and within five years the number will have doubled or trebled, Remington Rand President D. L. Bibby told the Eastern Joint Computer Conference meeting held here recently.

In the 15 years since the invention of the electric digital computer, the data processing industry has grown to annual sales of $1 billion, and its products have increased the computational ability of man by one million times over all previous recorded history, Bibby said. He predicted that by 1970 the value of communication equipment required to handle data transmission between computers "will be equal to the value of the computers themselves."

Bibby said the U. S. "holds a commanding lead over the Soviet Union in computer technology. Although the lead has shrunk, we can keep and enlarge it if we do not fall victim to complacency."

VTOL Crash Investigation

London—Investigation into the crash of No. 2 prototype of the Hawker Siddeley P.1127 VTOL strike fighter at Yeovilton Naval Air Station last week centered on in-flight loss of a forward nozzle of its Bristol Siddeley BS.53 deflected thrust engine.

The airplane, pictured on Aviation Week's Sept. 4 cover, was undergoing conventional test runs near Yeovilton with Pilot Bill Bedford at the controls when trouble occurred.

Bedford first experienced high speed oscillations and warned the Hunter jet chase plane pilot that he was heading for Yeovilton, declaring an emergency.

The four nozzles of the BS.53—two forward made of glass fiber for the cold air section, and two aft nozzles of metal for hot air—were locked in the horizontal position at the time.

Bedford started his approach to Yeovilton's main runway, but decided to eject at 200 ft. due to lack of roll control on final approach. The plane hit the runway and burned. Bedford, using the Martin-Baker zero level ejection seat, escaped with bruises.

Two days later, a farmer living about 2 mi. off the end of the runway brought a forward fiber nozzle to Yeovilton. He found it on his property at about the time of the crash.

Test program sources consider that loss of a forward nozzle in final approach configuration would produce a strong asymmetric thrust, seriously affecting control.

Bristol Siddeley had previously redesigned the forward nozzles for metal alloys and all four will be made of metal for No. 3 prototype, which is due to roll off the Hawker Aircraft line early in January to resume the level flight regime test program. No. 1 prototype is used for VTOL landings and takeoffs.

NASA Geophysical Observatory Satellite Will Carry 19 Experiments

Washington – Orbiting Geophysical Observatory (OGO), to be launched in 1963 aboard an Atlas Agena B, will carry 19 experiments in modular compartments and booms, according to the National Aeronautics and Space Administration.

The geophysical satellite structure is being built by Space Technology Laboratories, Inc., and is the first standard structure among NASA's second generation satellites. The 900-lb. spacecraft will be 6 ft. long and 3 ft. square. It will be powered by solar cells.

OGO will have standard power supplies and telemetry, and experiments will be designed to fit in modules.

First flight will have an elliptical trajectory, ranging from 170-70,000 mi. It will be called EGO, for eccentric orbiting geophysical observatory. Later missions, flown from Pacific Missile Range, will be called POGO, for polar orbiting geophysical observatory.

Experimenters will meet at NASA's Goddard Space Flight Center in a few months to discuss the program. With their experiments, they are:

K. A. Anderson of the University of California at Berkeley, solar cosmic rays; J. A. Simpson, T. Meyer and C. Y. Fan, University of Chicago, low energy galactic cosmic ray flux; J. A. Van Allen, State University of Iowa, trapped radiation, outer belt electrons; J. R. Winckler, R. L. Arnoldy, University of Minnesota, trapped radiation, electron spectrometer; E. J. Smith, Jet Propulsion Laboratory, and R. E. Holzer, University of California in Los Angeles, fluctuations in vector magnetic field; Michel Bader, Ames Research Center, electrostatic analyzer; H. Bridge, Massachusetts Institute of Technology, proton and electron plasma probe; Rita C. Sagalyn and M. Smiddy, Air Force Cambridge Research Laboratory, spherical ion and electron trap; R. C. Helliwell, Stanford University, and L. H. Rordan, Stanford Research Institute, VLF noise and propagation; F. T. Haddock, University of Michigan, radio astronomy; R. S. Lawrence and H. J. A. Chivers, Central Radio Propagation Laboratory, Bureau of Standards, radio beacon; P. Manage, Naval Research Laboratory, Washington, D. C., Lyman-Alpha scattering.

The Goddard Space Flight Center, has the following experimenters: T. L. Cline, and E. W. Hones, Jr., of the Institute for Defense Analysis, positron and gamma ray detection; L. R. Davis, trapped radiation studies; F. B. McDonald, and D. A. Bryant, National Academy of Sciences fellow at Goddard, galactic cosmic rays and isotope abundance; J. P. Heppner, rubidium vapor magnetometer; E. C. Whipple, planar ion and electron trap; H. A. Taylor, Jr., and N. W. Spencer, ion mass spectrometry; W. M. Alexander and C. W. McCracken, micrometeoroids; vectro velocities.

Joint Atomic Committee Planning Hearings on Radioactive Fallout

Washington—While the Atomic Energy Commission continues its evaluation of Russia's recent nuclear tests, Congress is laying the groundwork for the first hearings on radioactive fallout since 1959.

The upcoming Joint Congressional Atomic Energy Committee hearings, besides delving into the extent and consequences of fallout, also will provide a forum for debating whether the U. S. should resume nuclear tests in the atmosphere, barring an earlier decision by President Kennedy. Hearing dates have not been set.

Chairman Chet Holifield (D.-Calif.) is among those in Congress pressing President Kennedy to resume atmosphere testing. Rep. Holifield contends the U. S. cannot afford to risk falling behind the Russians in nuclear technology, and that atmospheric testing is essential to continued progress.

Propaganda Battle

President Kennedy apparently wants to delay resumption of atmospheric testing as long as practical, partly to emphasize that it was Russia—not the U. S.—which broke the moratorium. Russia has been trying to get out of this spotlight by pointing to the U. S. underground nuclear tests.

AEC Dec. 17 provoked new Russian accusations by announcing that a low yield nuclear test was conducted underground at the Nevada test site. Soviet Ambassador Mikhail A. Menshikov in a television interview said if such tests "are not stopped at once, then of course we will start our tests again, and not only ordinary bombs, but perhaps superbombs also."

Prague radio, in a broadcast to Yugoslavia Dec. 14, said earlier U. S. charges that the Russian atmospheric tests are "dirty" had been contradicted by the AEC (AW Dec. 18, p. 33). "Therefore," the broadcast said, "let us stop calculating the percentages of radioactive fallout and agree on general and total disarmament."

Fallout Debate

However, the fallout debate is intensifying. Gordon M. Dunning, deputy director of AEC's division of operational safety, last week said Russian nuclear tests over the years—not just the recent series—have caused more fallout than those of the U. S. and United Kingdom combined. Dunning said Russia's 1961 nuclear tests produced 120 megatons of total energy yield, with 25 megatons of that total coming from fission. Fission products fall on the earth.

The amount of long-lived radionuclides (strontium 90 and cesium 137) which fall on the U. S. from the Russian 1961 tests will be equal to or a little more than that from all previous U. S. and U. K. tests, Dunning said. He said Russia's tests will deposit 45 millicuries of strontium 90 per square mile and 80 millicuries of cesium 137 per square mile. This compares with 40 and 70 millicuries for those radionuclides deposited by U. S. and U. K. tests.

Counting the amounts that may be deposited from all Russian tests, AEC estimated 90 millicuries per square mile for strontium 90 and 160 millicuries per square mile for cesium 137. The agency said this would be twice that from all past U. S. and U. K. tests.

Witnesses are expected to debate the significance of these and other fallout figures at the congressional hearings. A related set of hearings also is planned for next year by the House Government Operations Military Operations Subcommittee on civil defense against nuclear weapons. Rep. Holifield is chairman of that subcommittee.

French Cancel Plans For C-130 Purchase

Paris—French government has decided the Berlin situation no longer requires the emergency purchase of Lockheed C-130 heavy transports for the French air force.

Last month, before his visit to Washington, French Defense Minister Pierre Messmer told the national assembly he was considering buying U. S. heavy transports to honor commitments on Berlin (AW Nov. 30, p. 26). Objection to such purchase was strong from certain industry quarters. It was feared the purchase would drain funds from French airframe programs currently under way.

When a supplementary budget bill was recently put before the assembly, a government spokesman said the plan to buy four C-130 transports was now dropped. Instead, about $7.3 million was put into a supplementary budget bill to speed prototype development of Nord Aviation's Transall cargo project, currently being built jointly by France and West Germany.

The government spokesman admitted it would still be some time before Transalls would be operational, but added that the international situation no longer required emergency purchases of U. S. aircraft.

Other military items covered by the supplementary budget bill include $8.5 million additional credit for the French Navy's first helicopter carrier, La Resolue.

Other items reflect drying up of U. S. military aid to French forces. One $10 million item, for example, is for additional jet engines for French air force North American F-100s originally given to FAF under the military assistance program. Another $6.6 million item will finance a retrofit program for F-100s so the aircraft can be armed with nuclear weapons out of NATO's nuclear stockpile.

Proposals Are Due For NATO Strike Fighter

Paris—Design proposals for the North Atlantic Treaty Organization's sharply-contested competition for a V/STOL strike fighter reconnaissance fighter are scheduled to be submitted here by late next week.

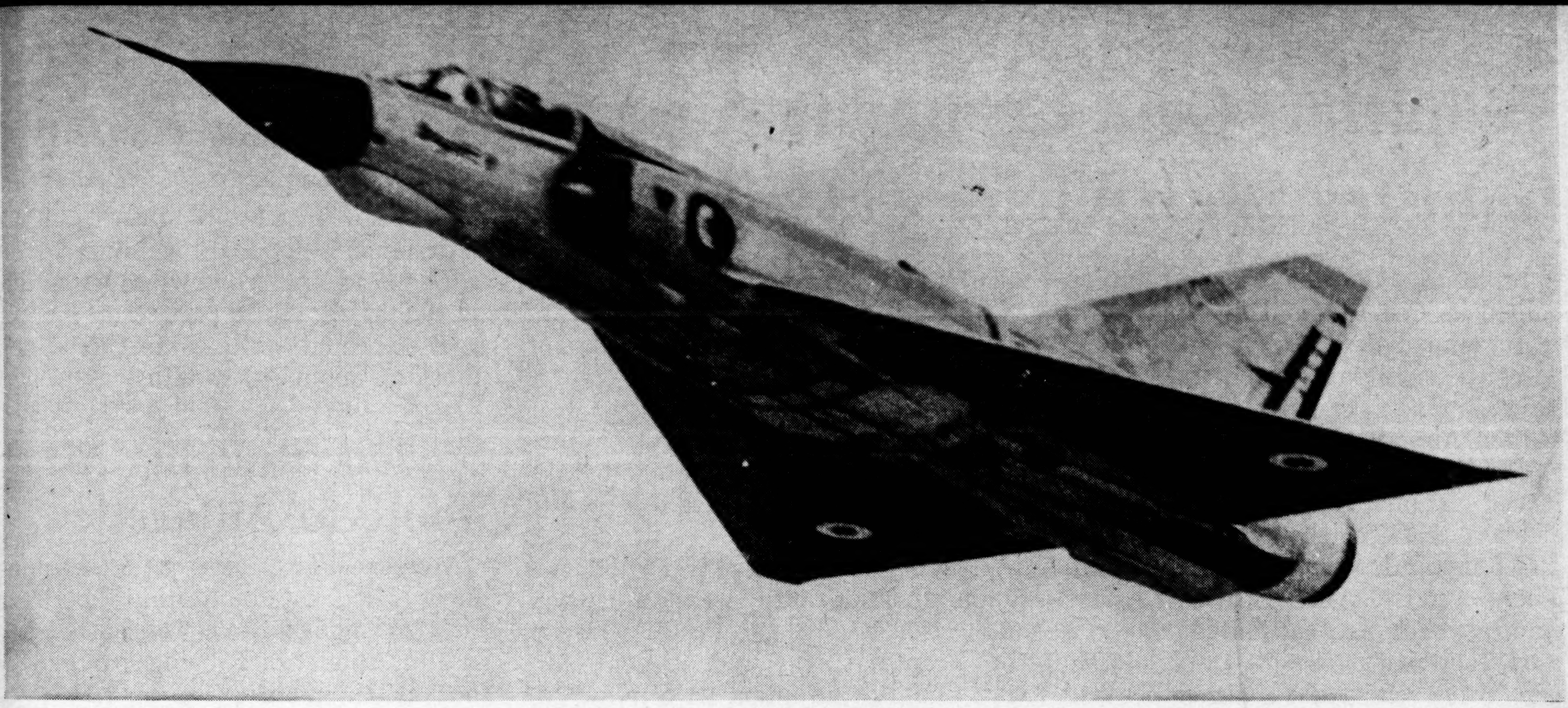
Although there have been persistent demands from some quarters that the specifications for the aircraft be revised, particularly from Germany (AW Oct. 23, p. 25), the basic minimum requirements stipulate a minimum on-the-deck speed of Mach .92 for a distance of at least 250 mi.

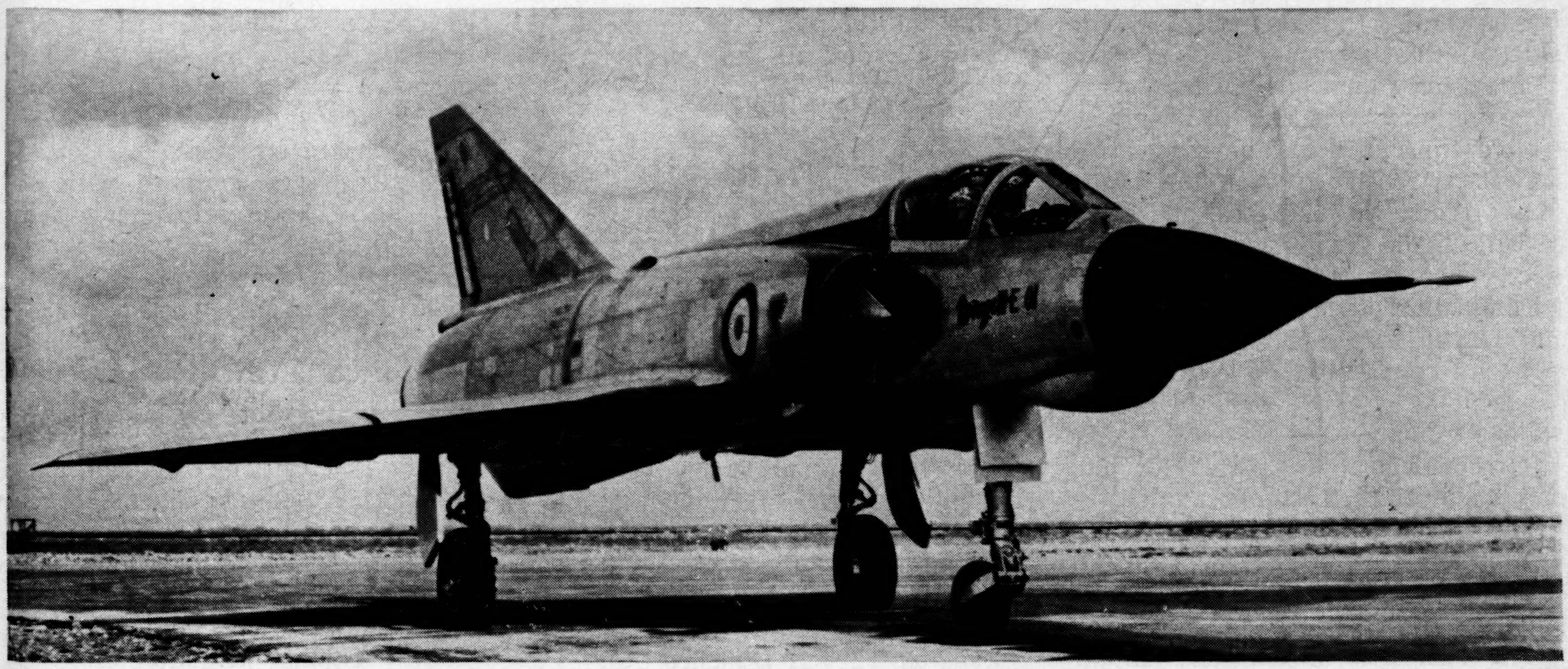
U. S. firms with prime proposals to fit NATO's Basic Military Requirement 3 include Lockheed Aircraft, with a V/STOL version of its Mach 2 F-104 in partnership with Britain's Short Brothers and Harland; and Republic Aviation Corp., with a variable sweep design in a consortium with Hawker Siddeley, Fokker, Focke Wulf, France's Louis Breguet and SABCA and Avions Fairey of Belgium. Bell Aerosystems also has assisted in the design of a German entry, the Messerschmitt-Heinkey-Bölkow VJ-101, and Ryan Aeronautical Corp. has considered the possibility of submitting an entry.

In another move, Bell Aerosystems also has joined an international industry group in a consortium plan designed to fulfill the NATO requirement for a supporting medium-range V/STOL transport.

Initial design studies in the competition, designated BMR 4, were submitted in late November.

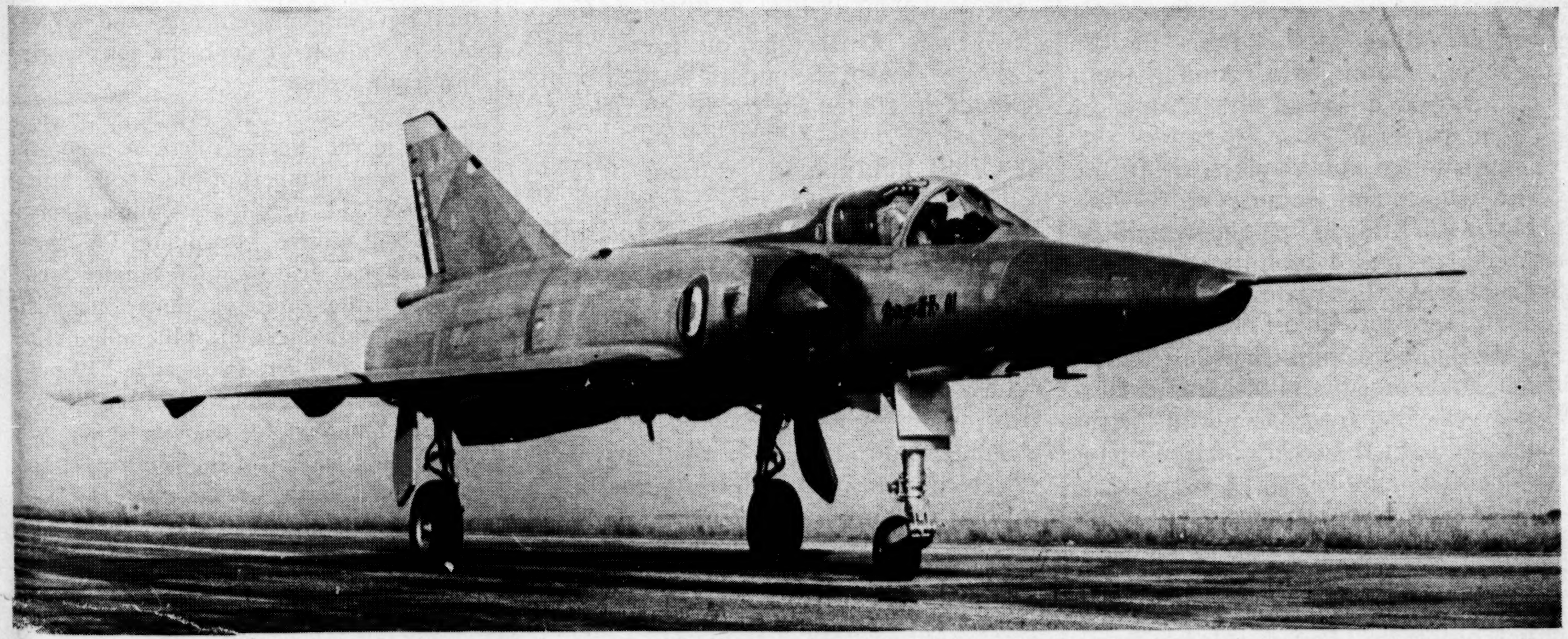
Collaboration agreement was signed by Bell with Hawker Siddeley, de Havilland of Canada, Avions Fairey and France's Nord Aviation. Designs submitted to NATO by Hawker Siddeley before the November deadline include a Mk. 2 version of de Havilland's Caribou turboprop transport (AW Nov. 27, p. 23), possibly including incorporation of pure lift engines. Other U. S. firms with V/STOL transport proposals include Ling-Temco-Vought and Douglas.





First photos show Dassault's Mirage 3-E. This French all-weather interceptor can also function as a ground-support aircraft, a capability lacking in the production Mirage 3-C. The Mirage 3-E has a cannon pod under the radar nose and a rocket pack under the tail for high-altitude interception. French air force plans to follow production of several hundred Mirage 3-Cs with the E version.

Close-Support, Photo Versions of Mirage 3 Tested



Mirage 3-R reconnaissance model, of which two prototypes are flying, has nose camera installations, one beneath nose probe and another further back on nose. French air force has ordered this version of the Mirage 3 in limited quantities.

Teamsters Gain Ground in Aircraft Industry With Victory at Sikorsky

Stratford, Conn.—Teamsters union gained its first foothold in a major aircraft company last week, winning by 93 votes the right to represent hourly employes at Sikorsky Aircraft Division of United Aircraft Corp.

Of 4,929 employes eligible to vote in the National Labor Relations Board election, 2,377 picked the Teamsters, 2,284 the Independent Aircraft Guild. There were 31 votes challenged, not enough to change the outcome, for a total valid vote cast of 4,692. Fifty-nine votes were voided, either because ballots were left blank, signed or marred in some other fashion, and 178 employes did not vote.

Teamsters campaigned on a 20-point program, many of them involving increased fringe benefits, but some that may mean resistance when the Teamsters organize the new local and begin to bargain for their first Sikorsky contract. These issues include:

- **Elimination of the merit raise** system and substitution of an automatic progression formula based on length of employment.
- **Closed shop.**
- **Job openings** to be posted for bid, presumably on the basis of seniority.
- **Shift preference** by seniority.
- **Arbitration for all grievances** instead of only certain grievances under present practices.

The Teamsters disclaim any current interest in organizing other aircraft plants. Their attitude is to move into any plant where the climate is receptive, but not to waste substantial amounts of money in hopeless organizing efforts.

The election resulted in local controversy when the Teamsters published an advertisement a few days prior to the election carrying an endorsement from 30 other local unions in the Bridgeport, Conn., area. Among them was the local union of the Bridgeport police department.

This resulted in exchanges within the police department because of the implications if Bridgeport police would be required to police a future strike at Sikorsky.

The Teamsters union claims 10,000-15,000 membership in its Industrial Division, including locals at Minneapolis-Honeywell Regulator Co. and Diehl Electric Co., a subsidiary of the Singer Sewing Machine Co.

The Teamsters have solicited members at Lockheed-Marietta in Georgia, where an existing local of the International Assn. of Machinists ran into internal problems. But the local union has since reorganized. Teamster headquarters in Washington said it would not send organizers into the area until there was sufficient interest to warrant an extensive campaign.

Sikorsky employes previously were represented by the United Auto Workers, AFL-CIO. After a protracted strike last year, the employes voted to decertify the UAW.

The employes remained without a union affiliation until last month when an election was held to decide between the Teamsters, the Independent Aircraft Guild or no union (AW Nov. 20, p. 27). None won sufficient votes to qualify and the runoff election between the two leaders in that election was scheduled.

Satellite Data Alters Radiation Belt Theory

Washington—Outer Van Allen radiation belt is made up largely of protons, rather than electrons as had been theorized previously, according to data transmitted by the Explorer 12 satellite.

Although the electron concentration in the belt is considerably less than that indicated by earlier satellites, the National Aeronautics and Space Administration said there are enough to present a hazard to manned space flight.

Explorer 12 was launched Aug. 15 as the payload of a Delta launch vehicle. It had an expected transmission lifetime of a year, but transmissions ceased without warning early this month after 102 orbits, each lasting 26.5 hr.

The satellite carried 10 particle detector systems, including electron sensors developed by Dr. James A. Van Allen and Dr. Brian J. O'Brien from the State University of Iowa. Leo Davis of NASA's Goddard Space Flight Center developed the proton particle experiment.

Other information returned by Explorer 12 indicates:

- **Some protection** is desired for solar cells, based on degradation observed from unprotected cells, and cells protected by glass coatings with thicknesses of 3, 20 and 60 mils. Unprotected cells degraded by 50% after two orbits, 3-mil coating resulted in a 5% degradation, and no power loss was observed from cells with heavy coatings.
- **Solar pressure** acting on the solar cell paddles increased the satellite spin rate from 27 to 33 rpm.
- **Full time history** of four solar storms was obtained, and data should provide new information on proton events. Because of the large mass of information returned—more than 3 billion data bits—data reduction will not be completed for another six months.
- **Successful first use** of silver cadmium batteries in a Goddard satellite.

The dead satellite now has an apogee of 48,000 mi. and a perigee of 497 mi. It is expected to re-enter the atmosphere in about 20 months.

Soviets Studying Air Route to Antarctic

Moscow—Possibility of establishing direct air communication between Moscow and the Soviet polar research base in Antarctica is being explored by the Soviet Union.

An Il-18 and an An-10 left Moscow Dec. 15 on 25,000-km. trip which is expected to include stops at Delhi, Rangoon, Jakarta, Darwin, Sydney, Christchurch and possibly the U. S.'s Macmurdo Antarctic Base.

The Il-18 was equipped with fuel tanks and is expected to remain a few days at Mirny, a Soviet polar base, before returning to Moscow.

The An-10 cargo version will be fitted with skis at Mirny and make several flights in the Antarctic hinterland, including the Soviet station at Vostok in the area of the South Geomagnetic Pole carrying cargo and group researchers. Expedition Chief Alexander Afanyasev said that establishing air communication, if successful, would reduce time needed to relieve the Soviet Antarctic expedition staff from more than a month required heretofore by ocean ship to four or five days, even including intermediate landings.

Apollo Subcontractors

Washington — North American Aviation Space and Information Systems Division last week announced selection of four top tier subcontractors and award of $81 million in contracts for Apollo spacecraft systems.

The subcontractors, which were included in the North American proposal as preferred members of the Apollo team (AW Dec. 11, p. 37), are Collins Radio, which will receive $40 million for communications, television, telemetry and capsule intercommunications systems; Minneapolis-Honeywell, $30 million for the flight controller; AiResearch, $10 million for environmental system, and Radioplane, $1 million for recovery system.

Formal selection of the subcontractors came when North American and the National Aeronautics and Space Administration signed the contract for the Apollo capsule. Negotiations have been under way since early this month (AW Dec. 4, p. 26).

Disarmament Dispute

Washington—Controversy has developed within the Senate Foreign Relations Committee as to whether a survey on the economic impact of disarmament should be released to the public. The study was made by the staff of the disarmament subcommittee, headed by Sen. Hubert Humphrey (D.-Minn.). It is based on the replies to questionnaires sent to 140 major defense contractors, plus 300 other firms (AW Feb. 13, p. 26).

USAF Aids UN From France Despite Ban

Paris—U. S. Air Force aircraft are continuing to use French airfields in support of the United Nations effort against the secessionist Congo province of Katanga.

The aircraft, turboprop Lockheed C-130s of the 322nd Air Division located at Evreux and piston-engine Douglas C-124s at Chateauroux, are not affected by a French ban issued earlier this month prohibiting planes with ammunition destined for the UN forces to operate over France's territory or from its airfields.

France, a strong opponent of the Katanga action, has been supported by the former French Congo, which has drafted a similar prohibition and closed its airport at Brazzaville to such aircraft.

USAF planes used to ferry troops to the Congo in support of the Katangese operation have no UN-bound ammunition aboard on flights from or over France and, on their routes into Africa, are avoiding the territory of the former French Congo.

An Air Force spokesman in Wiesbaden said last week that, thus far, he could only say that the French prohibition has not affected the efficiency of the U. S. airlift operations in support of the Congo operation.

Gen. B. A. Schriever, commander of the Air Force Systems Command, attended the briefing. He said it was the first time such an Air Force-Army meeting had been held at that high a level. Gen. Schriever was accompanied by Lt. Gen. Howell M. Estes, Systems Command deputy for aerospace systems, and Maj. Gen. Osmond J. Ritland, commander of the Systems Command's Space Systems Division.

Flight Test Scheduled For Sounding Rocket

Washington—An 18-lb., 4.5-ft. long meteorological sounding rocket that will cost from $400 to $700 has been developed by Atlantic Research Corp. First flight test will be made from Wallops Island, Va., next month.

Called Metroc, the long-burning solid propellant rocket will carry a 3-lb. payload to 100,000 ft. Using a 2.75 folding fin aircraft rocket as a booster, it will carry the payload to 265,000 ft. Payload will sense temperature, pressure and humidity and will telemeter results. It also can carry a bag of chaff for determining wind direction by radar observation.

Both the rocket and payload were developed with company funds. Metroc is aimed at government and university markets. It would be used for sounding missions now handled by balloons. A parachute deploys at peak altitude to slow descent of the payload and give longer continuous readings. Metroc can be fired from its own tube launcher or from adapted closed-breech launchers used for firing the company's Arcas sounding rocket.

News Digest

USAF-Boeing Minuteman three-stage solid propellant missile was successfully fired 3,600 mi. over the Atlantic Missile Range from a silo at Cape Canaveral, Fla., last week. This was the second successful silo shot in three tries and the sixth development shot from the Air Force Missile Test Center.

Convair 990 jet transport received its Federal Aviation Agency airworthiness type certification last week. Aircraft will be introduced on American Airlines routes early next year. Modified version of the 990 will be tested for certification at a later date.

University of Virginia will take over management of the Navy's long-range theoretical research program in rocket and jet propulsion from Princeton University, effective Oct. 1, 1962. The program, known as Project Squid, has been in existence since 1946.

De Havilland Trident DH-121 three jet transport is scheduled to make its initial flight Wednesday from the Hatfield Production Plant air field.

Sir George Edwards, managing director of British Aircraft Corp., has been appointed chairman of BAC subsidiary companies, Bristol Aircraft, English Electric Aviation and Vickers-Armstrongs (Aircraft).

French government has ordered nine MS 760 Paris 2 jet executive aircraft from builder Morane-Saulnier. Four-place aircraft is powered by two Turbomeca Marbore 4 turbojets. The new order brings company's domestic Paris jet executive backlog to 53. In addition, 91 orders have been placed by 10 foreign customers, including 36 to be built under license in Argentina.

Ira H. Abbott, 55, director of Advanced Research and Technology for the National Aeronautics and Space Administration, will retire Jan. 2 after 32 years as a government scientist and executive manager. Abbott said his future plans are indefinite, but he expects to make his home in New Hampshire.

Trailblazer 2 series began with a successful launch Dec. 14 from Wallops Island, Va., in the joint National Aeronautics and Space Administration—Advanced Research Projects Agency—Lincoln Laboratory study of re-entry physics (AW Dec. 18, p. 67). The four-stage rocket attained an altitude of 167 mi. and a re-entry velocity of 14,000 mph.

X-15 No. 3 Flies

Los Angeles—First flight of the No. 3 X-15 took place Dec. 20 with National Aeronautics and Space Administration test pilot Neil A. Armstrong at the controls.

The aircraft is equipped with an adaptive control system developed by Minneapolis-Honeywell which automatically changes gains in all three control axes as flight conditions dictate. The system also integrates the reaction control system with the aerodynamic system (AW Dec. 18, p. 34).

The 57,000 lb.-thrust Thiokol XLR-99 engine was held at 50% power for the flight. Maximum speed of 2,445 mph. was attained at 80,000 ft. It was Armstrong's third X-15 flight and his first with the design engine.

The flight had been delayed because recent rains had made the surface of Edwards Dry Lake too soft for landing. Total flight time was 11 min. from time of launch to touchdown.

Airlines Concerned Over Sales Programs

Closer look being taken at strategies as traffic continues to drop; scientific marketing may result.

By L. L. Doty

Washington—U. S. domestic trunk airlines, publicly blaming the 1961 traffic decline on a variety of factors, are staying silent on a problem which privately concerns a growing number of carrier officials—the ineffectiveness of current sales programs.

Throughout the development of modern air transportation, sales departments have been treated as privileged groups, favored with fringe benefits often denied other departments. The continued growth of the industry—a steady annual traffic increase of about 12-15%—appeared to make such treatment warranted.

Now, however, with traffic down this year an estimated 2% following a lean 1960 when the rate of increase was only 3%, many airlines are taking a close look at sales strategies. The result could well be a full transition from outmoded sales methods to long-range, scientific marketing programs within the next few years.

Some carriers have already launched marketing programs aimed at modernizing old sales approaches, but thus far, the effort has been meager. The prime problem has been heavy costs, particularly in the conduct of basic marketing research studies, starting point for all such programs.

Research Areas

Without research, determination of markets is pure guesswork. Today, airlines can only speculate on such problems as what deters some travelers from flying, the cause of the current trend from first-class to coach travel or effective means of tapping new traffic sources.

Most research conducted by the industry has been in the area of route structure and expansion, relation of flight schedules to area business activity and in preparation for Civil Aeronautics Board cases. American Airlines has a marketing research program. American, Eastern, TWA, United, Boeing and Douglas are currently sponsoring a survey of the travel market (AW Dec. 18, p. 47).

W. A. Patterson, president of United Air Lines, which has taken a significant lead in undertaking a marketing program, had this to say on the problem of traffic development:

"Members of our industry were permitted [by the Civil Aeronautics Board] to meet and agree on what they would provide in service to passengers. This, I believe, is contrary to the established way to succeed in public service. The first objective must be to learn what customers want in the form of service. Then, the cost of such service must be found, followed by determination of the customer's willingness to pay that cost, plus a fair return. . . ."

Disagreement on Market

Patterson said that the most serious problem is the difference in opinion between industry and the CAB, and even within the industry, as to what constitutes the potential market.

In the past, it has been general practice to relate airline traffic activity directly to the general economy. It has been fairly well established that airline traffic cycles closely parallel fluctuations of the gross national product (AW Feb. 29, p. 38) and other business barometers (AW May 1, p. 26).

But it has not yet been demonstrated what benefit an intelligent sales campaign would have on traffic during a moderate economic recession. A growing number of airline officials believe that the industry cannot afford to accept the theory that it is anchored to the general economy until it experiments with new marketing devices.

A slight recession in early 1961 is being blamed for the industry's dismal showing during the first quarter. But the general economy took a prosperous turn in mid-spring and the airline industry failed to respond.

Until November, monthly traffic gains were few and infinitesimal. Optimists are viewing the sudden upsurge in traffic in November—an 11% increase compared with a 3% decline in November—as a trend reversal and point to the fact that there is always a lag in the reaction of traffic to the national economy.

Others attribute the November upturn to unusually good flying weather throughout most airline systems. They say that November should be a busy travel period, but that cancellations and delays due to weather normally reduce traffic volume.

Despite November results, the lessons of the past two years, during which traditional growth trends came to a halt as capacity expanded, should stress the need for fortifying travel business against outside influences. As Patterson points out, there are divergent opinions as to how this should be achieved, but some ideas have emerged as the result of critical looks at current sales methods.

In general, the airlines have sold, and are continuing to sell, services as their prime product. This has been the chief weapon in the struggle for business.

This was effective as long as services were expanded and improved. Now, however, many sales officials feel that this emphasis on services, and on the equipment and personnel supporting these services, is achieving nothing.

Motorists Unaffected

They claim it is not penetrating into the private automobile travel market, the industry's chief competitor for a mass market and the largest potential source of a new market. Some officials state that the industry's present market is made up largely of experienced air travelers who are already acquainted with airline services and are no longer attracted by a sales pitch centered around services.

Others feel that the airlines have reached a peak in the services they can provide; that services are likely to be reduced rather than expanded because [illegible] element. Many feel that a pletely unprepared for the need to revamp their sales objectives. Because of a lack of an adequate market research study, the airlines were lulled into believing their market would continue to expand without interruption until at least 1970. There are still many who are convinced that the recent traffic recession is temporary; that population growth and business expansion will soon restore traffic increases.

The high cost of undertaking a major marketing program, and the inevitable disruption and realignment of sales departments that will result, have contributed to the industry's reluctance to make the move now. With profits being replaced by losses, additional expenses are being discouraged.

Nevertheless, the obvious need for some spur to new business, a real fear that the CAB may survey the industry's traffic problems through "adequacy of service" investigations and the possibility that more mergers will lessen the number of carriers is giving new force to the move toward new sales philosophies.

Lufthansa Orders Two Boeing 707-320Bs

Lufthansa German Airlines has ordered two Boeing 707-320B turbofan jet transports for delivery in the spring of 1963 and 1964. Price tag of the order is $12.4 million.

The airline's Boeing jet fleet delivered or on order now totals 26 aircraft, including five 707-420s, seven 720Bs, and 12 Boeing 727s. An additional 720B recently was lost in a training crash. Lufthansa's Boeing orders represent a total investment of $206.4 million, including spares.

The latest order was made necessary, Lufthansa said, by large-scale route expansions.

Lufthansa's 1960 deficit of about $9.75 million including depreciation and amortization charges was attributed primarily to the high cost of its new jet equipment, spares, extended servicing and maintenance facilities and higher insurance rates for the equipment. The 1960 deficit compares with a loss of $9.7 million for 1959.

Total revenue was $83.25 million in 1960 and $57.5 million in 1959.

Over-all capacity rose to 190 million ton/mi. in 1960 from 123 million ton/mi. the previous year, an increase of 54%. Ton miles sold during the same period were 109 million, 65% more than the 69.8 million in 1959. Passengers carried totaled 1,237,629 as opposed to 786,626 in 1959 for a 57.3% increase. Freight and mail amounted to 20,900 U. S. tons. Passenger load factor increased from 54% to 58%.

SAS May Reduce Convair 990 Order

Copenhagen—Scandinavian Airlines System, whose Fiscal 1961 losses surpassed those of the previous record loss established last year, is expected to take delivery of two of the four Convair 990 medium-range jet transports it had originally planned to purchase.

The airline, which last week reported a deficit of $17.36 million for the year ending Sept. 30, probably will cancel two 990s which it had ordered directly from General Dynamics but accept delivery of two 990 aircraft it is committed to lease from Swissair.

The carrier also has considered possible cancellation of the two Swissair 990s, but such a move would create a host of problems and could bring an end to the sweeping bilateral pact between the two lines under which the Swiss firm has been flying Sud Caravelles on lease from SAS for the past year and a half.

In an effort to cut costs, SAS probably will continue to trim its employment figures, and further top management shifts are expected. Personnel during the past year was reduced from a high of 14,635 on Sept. 30, 1960, to 12,900 at the end of the fiscal year, largely through employes leaving voluntarily and by not filling vacant positions, according to the company. A similar reduction in size may be contemplated for the current year.

Following a board of directors meeting here, the airline announced last week that total revenue over the past year amounted to $138 million while total costs, including depreciation and reserves, came to $155.36 million.

Fiscal 1960 losses, which stimulated a successful plea for state aid from Sweden, Norway and Denmark, totaled $16.28 million. SAS said the budget for the present year will "result in a reduced but still sizable deficit. A further reduction in all costs and increased rationalization operations will be necessary."

Losses over the past year, the airline said, apart from an unsatisfactory traffic development on intercontinental routes, specifically North Atlantic, were largely due to costs caused by the continuing transition to jet operations. These costs remain high, SAS said.

SAS revenue in Fiscal 1961, excluding aircraft sales, totaled $134.6 million as compared with $124.57 million the previous year. Aircraft sales accounted for another $3.4 million for the total revenue figure of $138 million.

U.S. Reconsiders Warsaw Treaty

Washington—Oral arguments conducted last week by the Interagency Group on International Aviation (IGIA) were recessed with assurances that a recommendation as to whether the U. S. should renounce the Warsaw Convention of 1929 would be submitted to the State Department soon.

The issue is whether the U. S. should withdraw from the Warsaw Convention which limits liability for death or injury to $8,300 on international flights or ratify the Hague Protocol of 1955 which amends the Convention to increase limits to $16,600. Proponents of Senate ratification of the Hague Protocol include airlines, insurance companies and law professors.

Opponents, who constitute a substantial majority of the 95 parties filing comments with IGIA, are mainly claimants' attorneys. Some 20 nations have ratified the Hague Protocol. A total of 30 is required to make it international law.

No official U.S. action has been taken on the Protocol as yet. The Eisenhower Administration did not submit it to the Senate until 1959 and the Senate Foreign Relations Committee has not yet held hearings.

However, the Kennedy Administration has shown an interest in renouncing the Convention, which would nullify the Protocol as far as U.S participation is concerned. As a result, Senate hearings on the issue can be expected when Congress convenes next year.

IGIA is composed of representatives of the State, Commerce and Defense Departments, Federal Aviation Agency and the Civil Aeronautics Board.

Red China Viscount Fuel

London—Red Chinese government has entered into negotiations with British Petroleum Co. to obtain fuel for six Vickers Viscount turboprop transports recently purchased from British Aircraft Corp. (AW Dec. 11, p. 47).

British Petroleum has no major installation in the Far East, aside from a business office in Tokyo. However, discussions have top-level political ramifications in that British Petroleum is 51% owned by the British government and talks could lead to other avenues of China-British raw material trade.

British Petroleum officials confirmed that Viscount fuel talks have started but said nothing has finally been settled.

FAA Orders Suspension of Supplemental

Washington—Operating certificate of Imperial Airlines, focal point of a controversy over supplemental carriers after one of its aircraft crashed recently, killing 77 persons, has been suspended by the Federal Aviation Agency until the airline can show cause why it should be allowed to resume operations.

FAA Administrator Najeeb E. Halaby took the action last week after a joint Civil Aeronautics Board-FAA investigation revealed deficiencies in Imperial's maintenance, pilot training, and record keeping. Halaby said the airline had voluntarily suspended operations since the crash but after the investigation he had decided to invoke a legal suspension.

Halaby said that in recent weeks he had revoked the operating certificate of an air taxi operator and suspended the certificate of another carrier until they bring their training and manuals up to FAA standards.

Halaby outlined the FAA problem in policing the supplemental industry. He said the supplementals coming under joint CAB-FAA jurisdiction, plus certain air taxi operators and contract airlines which come under FAA certification exclusively, total about 45 carriers. Since these airlines have no fixed routes the problem of policing them is particularly difficult. All FAA can do is set standards of training, maintenance, require manuals and sample the carriers' operating activities, Halaby said.

Halaby said his agency had the right to take into account the total capability of any carrier to meet operating standards. Carriers that operate without CAB economic regulation will have their management and economic status reviewed by FAA if they are operating near bankruptcy, Halaby said.

Earlier, Halaby and CAB Chairman Alan S. Boyd discussed their Dec. 15 meeting with representatives of 25 supplemental airlines held in conjunction with the FAA-CAB investigation of the supplemental industry.

They said the supplementals feel that in order to assure a healthy industry, they must have some form of permanent authority and a better knowledge of the amount and distribution of funds available for military airlift.

Boyd said the investigation revealed maintenance, training and bookkeeping deficiencies on the part of a few carriers. Most carriers, Boyd said, are operating within the law. He said the supplemental industry is like any other; most members are good and a few are bad. A similar investigation of the scheduled carriers would probably reveal similar deficiencies, Boyd said.

Both Halaby and Boyd said there is general agreement in the industry that what is needed is fewer, better and safer supplementals.

As to specific recommendations to guide future supplemental operations, Boyd said that there was little FAA or CAB could do until Congress settles the question of the airlines' existence. If neither of the CAB-sponsored bills (AW Sept. 18, p. 45) now before the Congress is passed, the supplementals will cease to operate after Mar. 14, 1962—the date their temporary operating authority expires.

If either bill is passed, the supplemental carriers will have permanent status and CAB can then impose standards or financial soundness, Boyd said.

DC-8 Modification

Los Angeles—Retrofit program to improve Douglas DC-8 directional control and stopping ability after abnormal or emergency landings is under way. Douglas reports that about 150 aircraft are being modified, 58 of these at the factory. By last week, 18 DC-8s had been retrofitted at its plant. Federal Aviation Agency ordered that the modifications be completed by the end of February.

Mechanical changes include providing additional hydraulic system accumulators (AW Oct. 9, p. 39) and more reserve braking power to increase controllability during landing roll, lessening possible imbalance between forward and reverse thrust after touchdown, and reducing possibility of hydraulic leaks.

Delivery to airlines of parts for changes began Nov. 25. Two days per aircraft are required to make changes. The majority of DC-8 user airlines are making the improvements at their own facilities, but some are flying DC-8s to the West Coast for modification in a two-day turnaround.

In the meantime, Halaby said, his agency would fine, suspend and revoke offenders' certificates for violations.

He also said the supplemental airlines were strongly urged by FAA to centralize their training programs, consolidate their maintenance functions and consider a single operational control system. "We made some progress," the administrator said.

Halaby hinted that the first step in this direction would be an inter-airline agreement to form and use a central pool of aircraft dispatchers. Such personnel must be employed by the certificated scheduled airlines to advise pilots of unforeseen weather hazards, weight problems and other factors of importance to the company.

Both Halaby and Boyd seemed genuinely concerned with preserving the supplemental airlines. Boyd cited the contributions the supplementals had made during the Berlin airlift, the Korean War and Hungarian refugee operations, in addition to creating an effective reserve of military airlift.

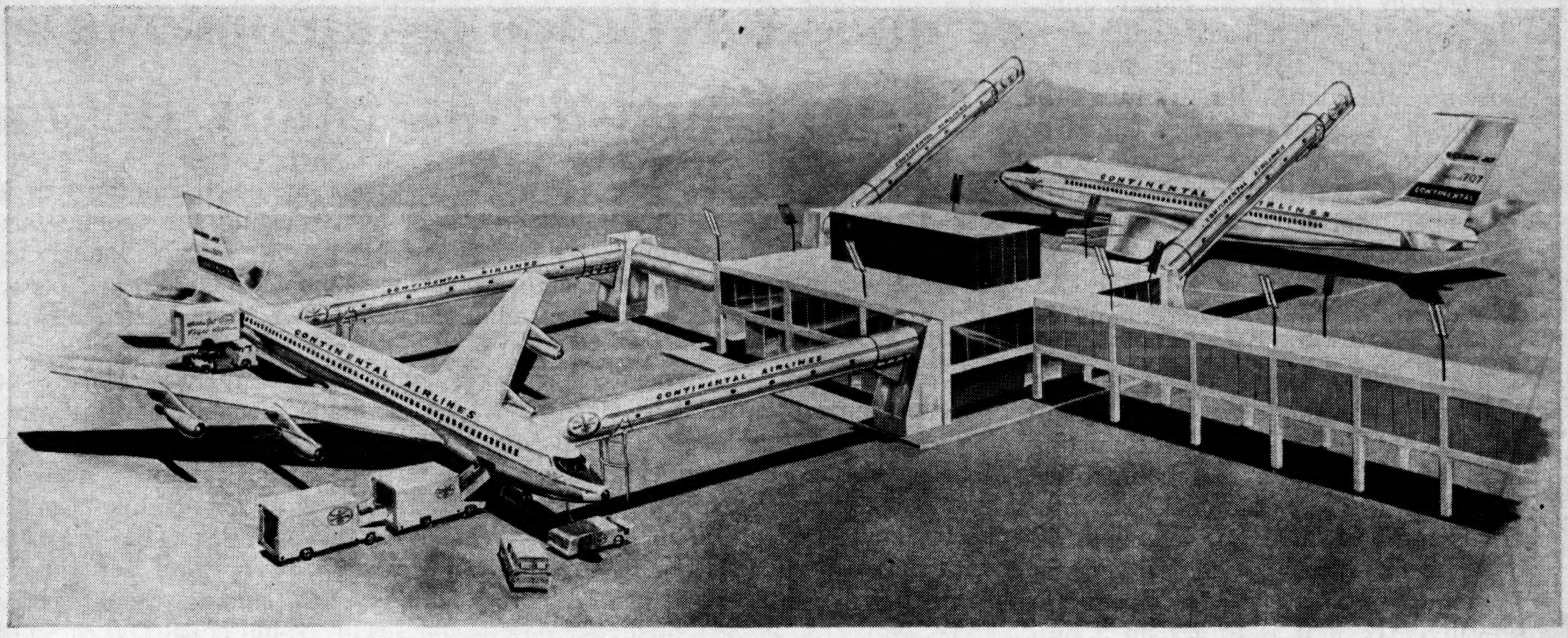
Boyd mentioned that the supplementals were bitter over the publicity they had received from the press. He asked the press to recall that during 1956-58 the supplementals did not have a single fatal accident involving passengers. In 1959 the supplementals had one passenger fatality. The present furor, he noted, stems from two fatal accidents in 1960 and two in 1961, in addition to an incident in which a group of passengers were stranded in Ireland.

Aeroflot Reports on An-24 Transport

Moscow—Russian twin-turboprop An-24 short-haul transport has been put into quantity production after encountering flight-test problems and undergoing major changes in seating configuration.

In the latest of a long series of announcements that the An-24 would go into regular service soon, Aeroflot revealed that:

- **An An-24 almost crashed when it went into a spin during flight tests. Extensive investigation purportedly showed that the aircraft was not at fault since it should not have been subjected to the flying regime which put it into the spin, Aeroflot said.**
- **New seating configuration will accommodate 44 passengers. Earlier reports said the An-24 would carry 32 passengers in its basic version and 40 in tourist service.**
- **An-24 cruising speed is about 470 kilometers per hour (292 mph.) instead of the 500 kph. (310 mph.) first mentioned. Even so, this will be 50% faster than the cruising speed of piston-powered Il-14s which An-24s will replace, along with Il-12s, Li-2s.**
- **Fuel consumption of An-24s is considerably less than for Il-14s, despite increased payload.**
- **An-24 carries a folding passenger stair which is lowered through a door in the fuselage tail. Entry to the passenger cabin is also possible through the cargo hatch in the forward part of the fuselage.**
- **Numerous trials from unpaved runways have confirmed that the An-24 can take off in even less than the 1,600 ft. mentioned in performance estimates.**



Continental to Load Passengers Via 'Drawbridges' at Chicago

Aluminum "drawbridge" passenger boarding ramps will be installed by Continental Airlines at O'Hare Field, Chicago, and are expected to be in operation at the carrier's new gatehouse in January. The 80-ft.-long, 8.5-ft.-dia. tubular structures can be raised 35 deg. and swung horizontally in a 20-ft. arc. Emplacement time is 20 sec. Last 6 ft. of the ramp telescopes.

Excursion Rate Repeal Brings Protests

By Glenn Garrison

New York—Airlines involved in the holiday confusion and ill will brought on by sudden suspension of the transcontinental excursion fare still were trying last week to unsnarl the problems of advising customers of the fare change.

Meanwhile, Civil Aeronautics Board was receiving volumes of complaints from disappointed ticket-holders who blamed the Board for the mix-up.

The Board announced Dec. 13 that the fare, good until Dec. 15, would not be extended. Mass confusion and complaining followed.

While the airlines are not officially blaming the Board, the CAB feels many complaints of irate travelers are being bucked to the Board by the carriers. The Board also believes the airlines might have avoided the holiday confusion by filing for an extension covering the holiday period only. As a result of what it believes to be unjust criticism, the Board is most unhappy with the carriers involved.

Furthermore, both United and American opposed the excursion fare and went along with TWA's request for extension to March for competitive reasons only.

Another source of criticism of the Board has been editorials attacking the Board for alleged bureaucracy and red tape in its handling of the matter.

The excursion fare, filed last August by TWA with American and United following suit reluctantly, expired Dec. 15 and the Board announced on Dec. 13 that the requested extension would not be granted. A scramble ensued as the three airlines frantically tried to advise holders of excursion tickets that these tickets would not be valid at the reduced rate after noon on Dec. 15.

Last week the carriers still were trying to catch up with their notifications to ticket-holders booked through the rest of the holidays and up until March. American at mid-week was about three days ahead of the bookings. TWA was several days ahead. These two airlines were able to pinpoint holders of the excursion fare by sifting through their reservations cards. United had not noted on the cards which passengers held the excursion tickets and consequently had no way of notifying the holders. Following the CAB announcement, United at New York alone made about 1,000 phone calls to all coach passengers on several prime flights in an effort to find excursion passengers and notify them of the suspension.

Passenger Notification

Purchasers of the excursion fare tickets were supposed to have been notified of the possibility of cancellation. TWA stamped its tickets, while American and United relied on verbal notification. However, many passengers apparently hadn't gotten the idea and were outraged when they found they'd have to pay additional fare to make their trips.

Most, however, did pay the additional fare. United estimated only about 3% canceled out; American's estimate of known cancellations was 15% and TWA's was about 10%.

However, the percentages probably were higher because no-shows might have held excursion tickets.

TWA had called about 3,000 people by mid-week and said only one in 10 canceled his space. As an example of the magnitude of the task, TWA had to pull reservations cards for all flights and sift out the excursion passengers for notification.

This involved taking personnel off the reservations phones, where they were especially needed in the busy holiday period.

Majority of the excursion fare passengers were students and military personnel taking holiday vacations. In some cases, students without enough money to make up the difference—which was as much as $107 for a Boston-Los Angeles jet coach round trip—turned in their tickets for one-way tickets at the higher fare and accepted airline checks for the difference.

Some wanted to know if the airline would make up the difference in fares and were chagrined when the airline said no.

Also affected were passengers on incoming international flights, who held tickets of connecting flights at the reduced rate.

TWA said it had no expectation that the extension would be denied. It is unusual for CAB to deny an extension, according to the airline. Some airline officials suggested that future situations of this kind might be avoided by changes in CAB procedure allowing the carriers more time to process a fare change after the Board's decision. This, according the suggestions, might be accomplished by speedier Board consideration or by automatic procedures allowing more time after a decision.

One carrier, TWA, also said that specific procedures for warning the public in such cases possibly should be developed by the Board or by the airlines. TWA said it strongly warned its passengers that the fare was subject to CAB approval all during the period, whereas another carrier did not. According to this view, there should be standard warning procedures.

CAB acknowledges the possibility that procedures might be subject to improvement, but points out the existing flexibility airlines have if competitive factors allow. For example, fare proposals must be filed not less than 30 days before effective dates, except in special cases which require Board approval. CAB, if it is to act on a proposal, must do it within that time or the fare is automatically in effect.

If TWA and the other carriers in this case had filed two months in advance, a Board spokesman said, CAB probably would have made its decision within 30 days and the other month would have provided a cushion for making the adjustment. But airlines often want to file as close to the effective date as possible for competitive reasons.

TWA estimated that about 60% of its total coach passengers booked from New York to Los Angeles during the Dec. 15-Jan. 4 period were holders of the excursion tickets. The airline, in support of the excursion fare, says surveys carried out during the first two and a half months of operation showed 30% of passengers using the fare were new business.

But United doesn't believe the fare generated enough new business to justify itself. American estimates the diversion of excursion fare holders from higher priced tickets at 91%, and estimates it lost from $145,000 to $203,000 last September alone on the fare.

Tipton Is Re-elected As ATA President

Washington—Air Transport Assn. reelected Stuart G. Tipton as president and named five new directors at the annual membership meeting held Dec. 14.

The new directors are: C. E. Beard, president of Braniff Airways; C. E. Woolman, president of Delta Air Lines; R. L. Cummings, Jr., president of New York Airways; J. H. Connelly, president of Pacific Air Lines; C. C. Tillinghast, Jr., president of Trans World Airlines. Directors' terms are one year.

Jack M. Slichter was elected vice president and Cliff Stratton, Jr., was elected secretary.

Funds for Beacon Implementation To Be Sought; New Study Begun

Washington—President Kennedy will ask Congress for enough money in Fiscal 1963 to implement Project Beacon report's recommendation that a new, $500 million air traffic control system be developed during the next five years, according to Federal Aviation Agency Administrator N. E. Halaby.

Despite the President's emphasis on a balanced budget for the coming fiscal year, Halaby said last week, "We have been allowed enough money to proceed with these [the Beacon report's] recommendations." But the Beacon report (AW Nov. 13, p. 34) predicted that FAA's Research and Development Service may not need more than its current allocation of $65 million to get started on the new ATC system.

Although the report was generally concerned only with the flow of air traffic in the U.S., Halaby disclosed that a separate task force had been appointed to design a navigation and control system for the North Atlantic. This program, termed Operation Accordion by Halaby, is being furnished data by Trans World Airlines, the first carrier to rely on Doppler radar navigation systems on transatlantic flights.

Three major departments of the FAA —Flight Standards Service, Air Traffic Service and Research and Development Service—are sharing responsibility for Operation Accordion, an Agency spokesman told AVIATION WEEK. One aim of the project is to reduce separation standards over the North Atlantic. But any recommendations emerging from the study probably cannot be implemented without international accord.

Halaby, who toured Europe recently, believes there is a very substantial risk that Western allies of the U.S. will design and build an ATC system not compatible with the system recommended by the Beacon report. Unless closer working ties are established, he said last week, it will become difficult to control effectively aircraft flying over congested North Atlantic airways. Halaby also stressed the need for avoiding another VOR-Decca controversy by such cooperation and planning.

As a first step in this direction, Air Traffic Service has begun collecting traffic flow data from about seven European nations, FAA reports. This information, in the form of monthly reports, will continue to be received by the Agency until June, 1962.

On Dulles International Airport, the $110 million terminal scheduled to become operational here in October, 1962, Halaby suggested that "negotiating gladiators" of the airlines are attempting to get predicted landing fees lowered by criticizing the mobile lounge concept. Twenty of these lounges, each costing about $233,000, have been ordered by FAA to transport passengers to and from aircraft using Dulles.

Dulles' landing fees, Halaby said, will be higher than the national average but lower than those charged by several other international airports. Early forecasts indicate that airlines will be charged a minimum of 25 cents and maximum of 35 cents per thousand pounds gross landing weight per aircraft. This would equal $60 to $90 for an intercontinental jet transport.

At Washington National Airport, by contrast, fees recently negotiated with the airlines are 15 cents per thousand pounds of landing weight.

Because of the allegedly high cost of landing at Dulles, U.S. airlines generally have not been enthusiastic over the new terminal. Although Halaby denied that any carrier threatened not to operate from Dulles, he indicated that those that may be considering such action will find that "there are various ways in which they will be persuaded to use the airport."

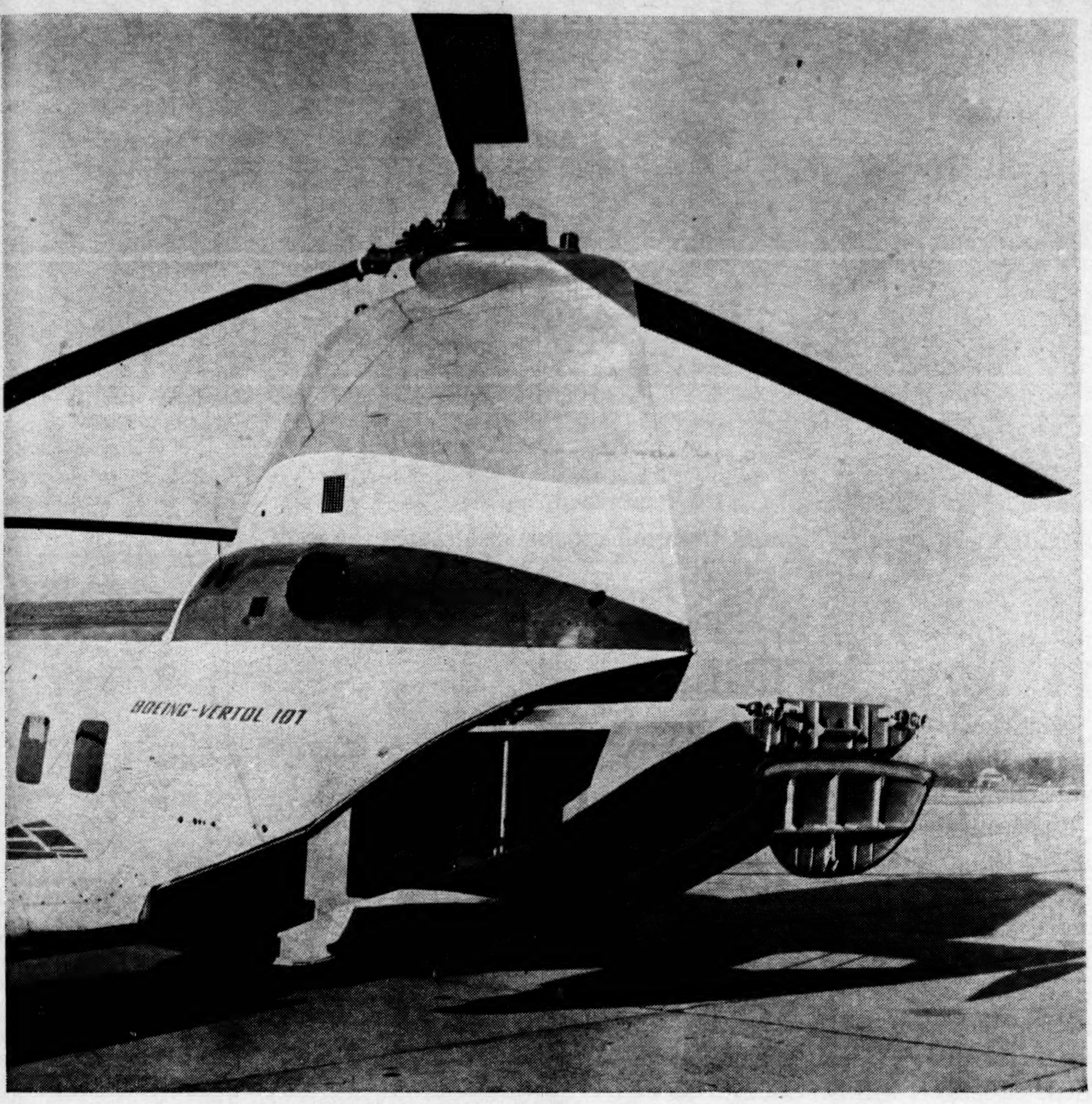
In his discussion of Dulles problems, Halaby said: "It's been asked if I'm as tough as Pete Quesada [former FAA administrator]. I think they [the airlines] will find me tougher—though a little more precise in selecting targets."

In line with a recommendation of the Project Tightrope task force (AW Nov. 27, p. 38), Halaby announced that FAA would appoint a group of new officials called "hearing officers" to afford a trial-type hearing to those accused of seriously violating civil air regulations. Such hearings would be held only when suspension or revocation of a certificate issued by FAA was a possible punishment.

The hearing officers will be lawyer employes of the agency. At the outset, three will be appointed, with two more to follow later. Much as judges of the U.S. Circuit Court, the hearing officers will travel through the FAA regions, trying cases as they arise.

Turning to airline industry financial problems, Halaby criticized the carriers for avoiding the subject of safety by pretending accidents don't happen. A basic fear of flying rather than ticket costs or schedule unreliability keeps those who have never flown from using the nation's airlines, he said.

"We've got to emphasize safety, not just alcohol and comfort," Halaby said, adding that "we need consolidated competition, not regulated chaos."



Boeing-Vertol 107 Baggage Bin

Removable baggage bin of Boeing-Vertol 107 twin turbine helicopter is shown in extended position. The bin can be removed at turn-around points and replaced with a bin pre-loaded with baggage. At intermediate stops, bin is pulled out, as above, and baggage removed from compartments formed by webbing. Unit hanging down at extreme right is fairing which covers latching mechanism.

Wage Demands Cited as Reason Airlines Want Fare Increases

By Robert H. Cook

Washington—Continuing wage demands by airline employes is being cited by many industry observers as the prime reason for the growing number of fare increase proposals now before the Civil Aeronautics Board.

Concern that the industry may be unable to regain a healthy rate of traffic growth in time to keep pace with future labor demands is being underscored by the sharp increase in labor costs brought about by turbojet fleet expansions. A slight reduction in flight crew members has been more than offset by the necessity for increased maintenance and sales personnel.

Airlines Apprehensive

The airlines are also apprehensive about wage costs in view of such potentially expensive measures as the mandatory retirement age of 60 for pilots and acceptance of the Feinsinger report (AW Oct. 23, p. 35), by flight crew unions and the airlines.

Spokesmen for the Flight Engineers International Assn. estimate that industry costs to implement the pilot training recommended for flight engineers in the Feinsinger report could approach $60 million over the next few years.

Further aggravating the wage-cost picture is the prospect that the Air Line Pilots Assn. may renew its past demands for more extensive copilot training. Airline concern over the high cost of providing this training was cited by the Federal Aviation Agency as a primary reason for not adopting the ALPA recommendations in full during Elwood R. Quesada's administration.

Over-all labor force in the scheduled airline industry has climbed from a total of 147,150 employes in 1958 to more than 166,000 by the end of 1960. Preliminary financial estimates show that the industry's wage bill has jumped $73 million this year, with $58 million of it in increased pay and fringe benefits, and the balance to new employes. For the year ending Sept. 30, the industry's employment total reached 171,610, with an annual total payroll of more than $1.2 billion. In 1958 the industry's payroll totaled $879 million.

As an example of the added burden of turbojet operations, Trans World Airlines reported a payroll cost increase of nearly $15 million in 1959.

The drastic drop in the industry's rate of annual traffic growth, which reached a meager 3% last year and is now predicted to show a 2% drop this year, underlines the airlines' immediate need for increased revenues.

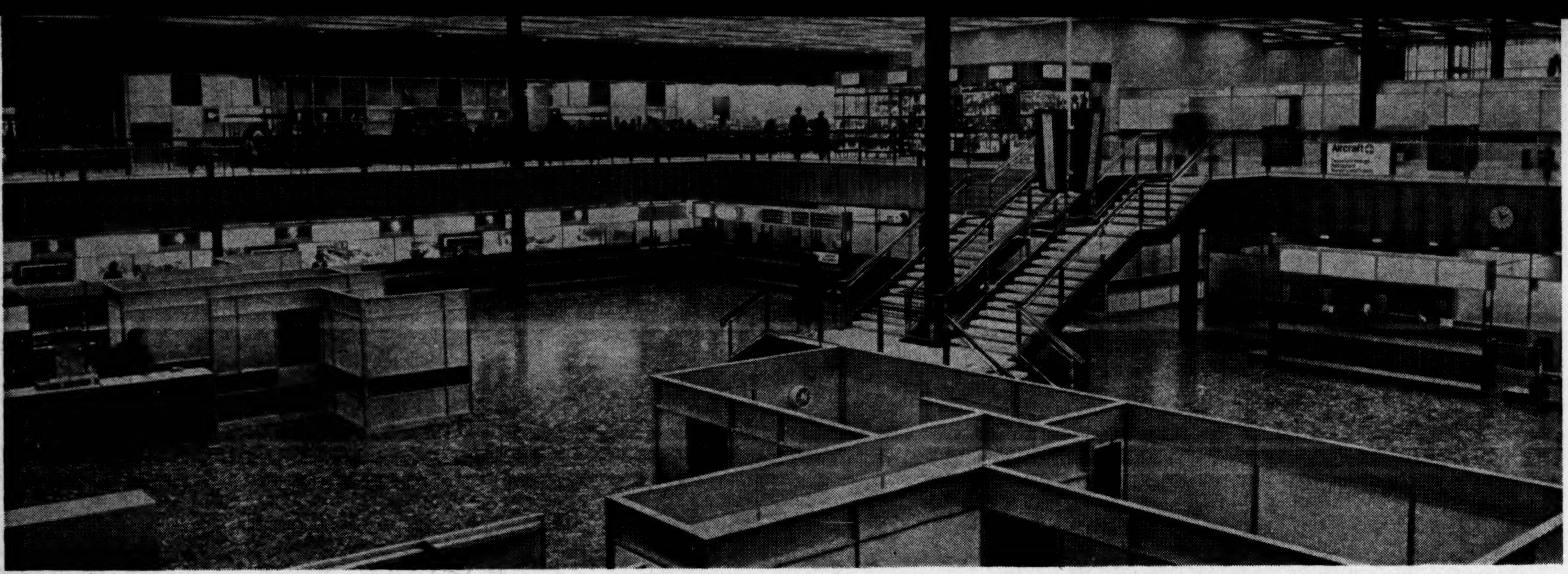
Utilizing the industry's revenue yardstick of 6 cents per revenue passenger mile, observers point out that the 1961 revenue passenger miles total would have to show a gain of nearly 1.2 billion just to cover the increase of $73 million in labor costs. This was almost exactly the total mileage gain recorded last year. Expressed in other terms, the airlines would need an estimated 4% increase in total operating revenues to match the increased costs of wages.

Coach Yield Inadequate

Wage costs also provide a significant clue as to why a majority of airlines have asked CAB for fare increases which would raise the yield on coach service nearer the level of first class. Trunk carriers estimated last year that about 37 cents of their revenue dollar was taken from coach service, as compared with 53 cents on first class. The actual yield on coach falls significantly short of meeting the carriers' total salary costs, which now claim more than 42 cents of the revenue dollar.

A rough breakdown of the salary expense, including the cost of fringe benefits, payroll taxes and traveling expenses, shows that nearly 14 cents of the dollar earned goes for flight crew costs. This sum approximates the carriers' average comparitive cost of aircraft fuel, oil and gasoline taxes, along with hull insurance and rentals. It exceeds the actual depreciation costs for both flight and ground equipment by about 3 cents on each revenue dollar. An estimated 11 cents of the salary cost is accredited to pilots and engineers and the balance to hostesses.

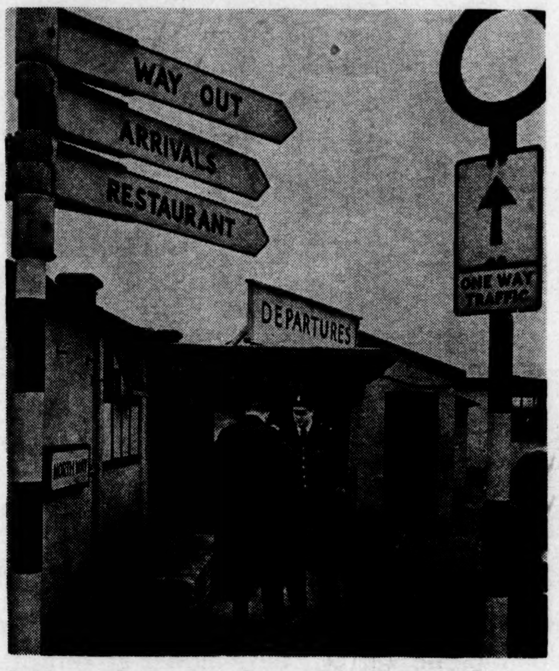
Aircraft overhaul mechanics' wages claim about 5 cents of the dollar; city sales and reservation personnel, 4 cents; line maintenance, 3 cents; airport reservation and ticket agents, 2 cents; cargo agents, 2 cents and record-keeping personnel about 2 cents. A variety of other employes, such as dispatchers, communications personnel and unassigned maintenance workers claim less than 1 cent of the dollar. Payroll taxes, fringe benefits and traveling expenses would consume 5 cents more of the earned dollar.



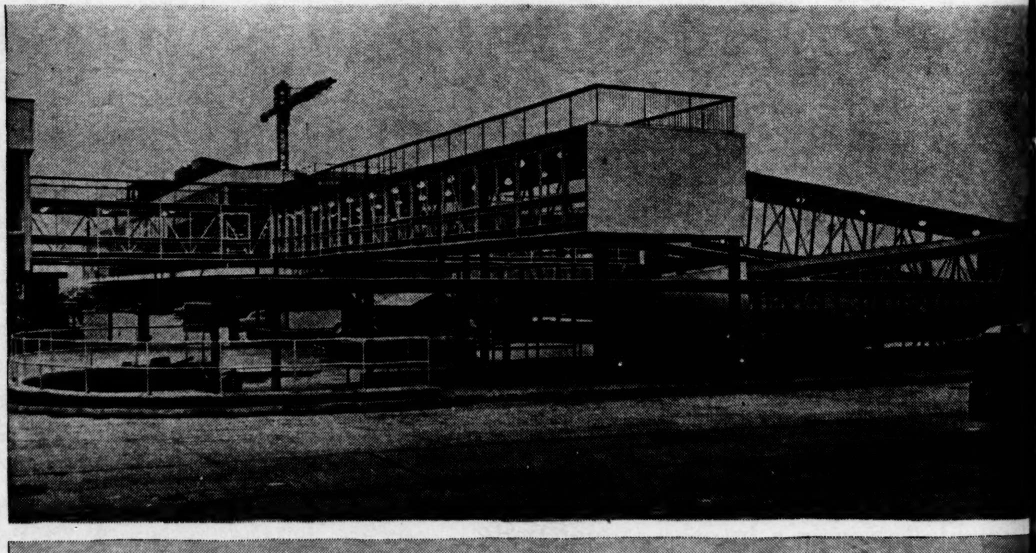
Interior of passenger terminal was designed to keep central area open, with most ticket offices arranged against the walls.

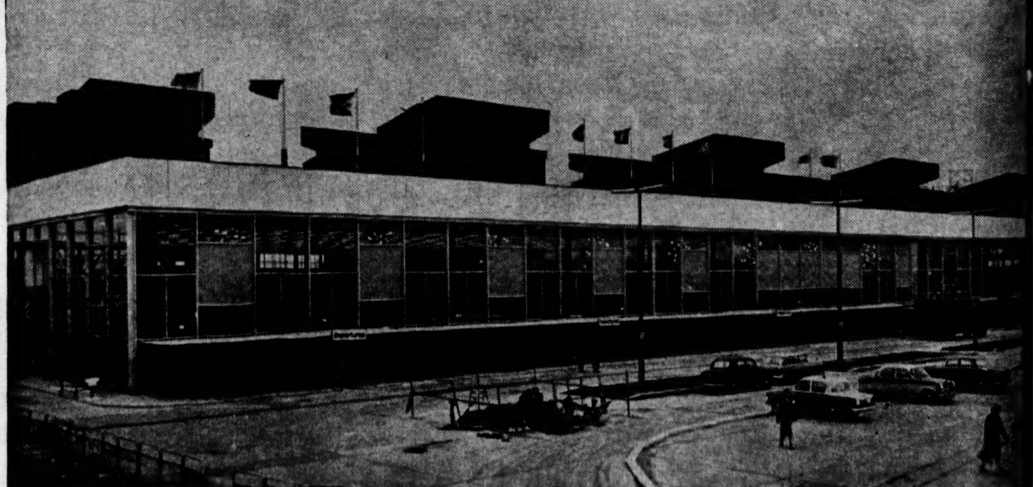
BOAC Occupies London's New Terminal

London—New international terminal at London (Heathrow) Airport, designed primarily for the long-haul airlines, was occupied for the first time recently by British Overseas Airways Corp., using the facilities for departures only pending completion of the structure. Terminal complex, built by Ministry of Aviation, eventually will replace the pre-World War II huts now used by BOAC for long-haul arrivals, along with other airlines. Upon completion in 1962, the new terminal (officially designated No. 3 Passenger Building) also will house TWA, Pan American, El Al, Air-India, Pakistan International, Aerolineas Argentinas and Panair do Brasil. Third phase will be completion of an adjoining airline office block, scheduled for occupancy in 1963. Design calls for a 430 x 280 ft. passenger service building, facing the main ramp, with two office blocks as wings on either side, measuring 411 x 55 ft. each. Ramp will have space for 30 airplanes; because of distances involved, and with no finger extensions provided, passengers will continue to be met by airline buses for transport to the customs area in the main terminal building. Under present plans, passengers will walk to the building if the airplane is within 1,000 ft. Departure lounge, designed in modernistic decor, can accommodate 350 persons; other facilities include 24-hr. restaurant, snack bar and duty-free liquor counter and shop. Entire complex will cost about $10 million. Bids are currently out for construction of a multi-story car park, to handle 1,000 automobiles, and set for completion in 1963.



Still much in use, but with their end now in sight, are antique huts at London North Terminal area. Area may become a freight center when the huts are torn down.



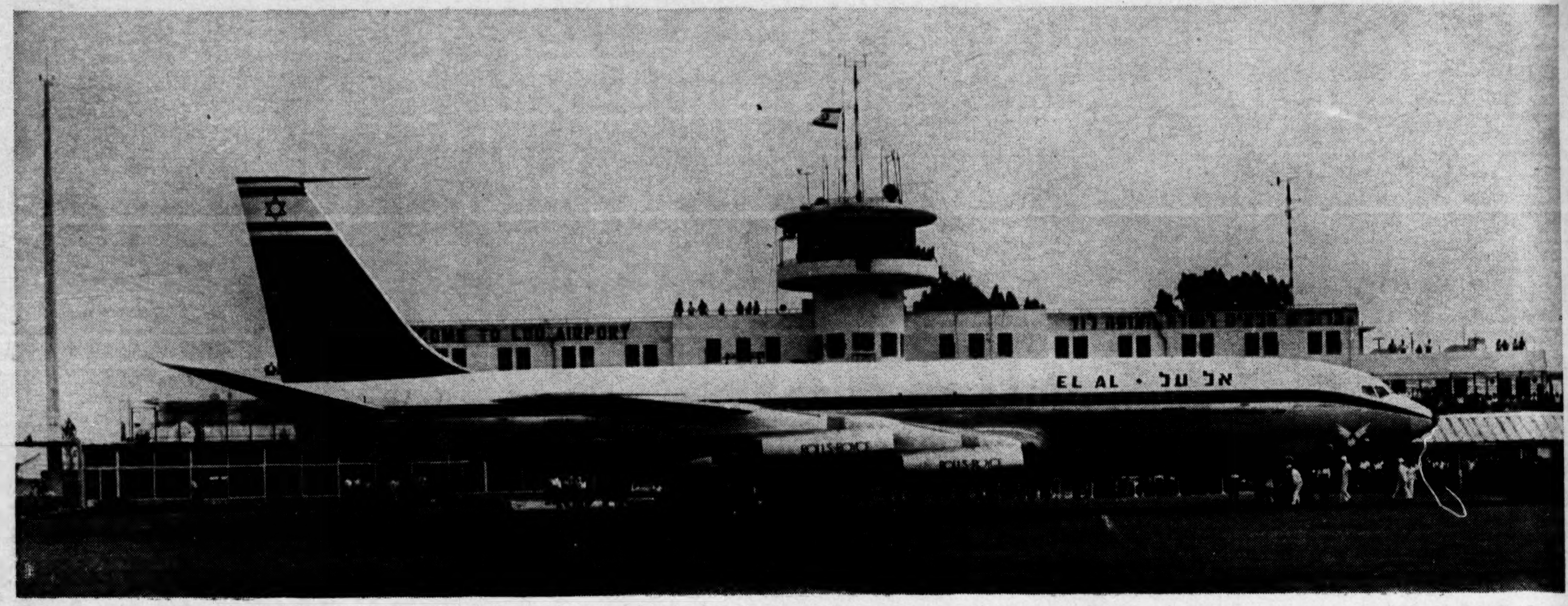


Snack bar area (left) on upper level of main building has room for expansion. Windowed passenger ramp (top, right) leads to main terminal and office blocks. Ramp may eventually be extended onto aircraft ramp by finger extension. Main entrance to London long-haul departure terminal (bottom, right) shows extensive use of glass.

Airline Traffic—October, 1961

	Revenue Passengers	Revenue Passenger Miles (000)	Passenger Load Factor %	U.S. Mail Ton-Miles	Express Ton-Miles	Freight Ton-Miles	Total Revenue Ton-Miles	Over-All Revenue Load Factor
DOMESTIC TRUNKS								
American	711,577	542,402	61.4	2,352,049	1,139,047	12,896,401	68,336,452	54.6
Braniff	205,138	96,716	59.6	424,851	214,100	1,030,136	10,931,988	47.7
Continental	112,947	72,897	45.3	307,661	145,729	647,253	8,088,148	37.4
Delta	313,726	185,968	56.1	704,560	411,719	1,932,071	20,903,315	47.8
Eastern	659,588	312,141	44.9	1,430,250	595,532	2,546,822	34,618,088	35.7
National	138,075	93,809	50.5	385,771	93,220	1,316,026	10,835,725	37.8
Northeast	125,447	51,876	42.9	166,013	66,487	233,499	5,426,046	36.4
Northwest	150,053	100,688	49.5	668,784	274,975	1,356,327	11,851,731	43.0
Trans World	423,837	377,737	53.3	1,563,196	803,523	5,832,649	44,375,963	45.3
United	987,076	636,367	55.4	3,992,653	1,398,023	9,708,179	75,984,452	49.7
Western	150,309	84,748	52.8	324,972	116,652	409,221	8,965,123	42.6
INTERNATIONAL								
American	6,613	7,055	46.4	6,200	1,074	340,708	1,080,094	45.4
Braniff	12,060	17,745	57.0	58,312	----	194,875	2,051,531	48.0
Caribbean Atlantic	32,559	2,212	60.0	2,139	----	11,978	210,210	57.0
Delta	946	1,078	23.1	1,411	----	14,773	130,359	23.6
Eastern	33,082	47,964	50.3	129,087	2,319	416,611	5,061,251	50.0
Mackey	5,558	1,556	34.3	----	301	4,950	157,639	30.3
National	74	37	46.8	----	----	----	3,978	39.8
Northwest	18,600	33,908	50.0	1,650,223	4,559	918,003	6,192,139	55.5
Pan American								
Alaska	3,774	3,784	36.0	38,380	3,214	235,486	674,936	42.6
Atlantic	147,588	262,999	61.0	3,216,920	----	6,125,555	36,459,406	56.3
Latin America	94,741	139,195	58.6	558,221	----	5,213,563	20,329,866	61.9
Pacific	45,779	178,788	67.6	3,643,096	17,193	3,903,211	25,941,524	61.6
Panagra	12,994	22,832	72.1	115,524	----	800,407	3,370,027	67.4
South Pacific	114	311	19.9	434	----	374	32,423	19.7
Trans Caribbean	3,818	5.707	72.4	----	652	185,813	667,009	72.7
Trans World	30,719	103,146	55.7	1,733,170	----	2,522,534	14,854,187	55.5
United	15,086	37,547	58.4	352,647	11,746	295,264	4,488,923	51.0
Western	4,874	7,641	55.3	12,801	----	23,237	825,568	46.7
LOCAL SERVICE								
Allegheny	76,399	15,694	43.9	28,367	56,614	93,143	1,675,866	48.4
Bonanza	28,265	7,051	49.5	6,632	2,565	13,693	699,747	50.4
Central	25,895	5,166	36.4	16,985	9,119	30,672	551,235	34.7
Frontier	29,546	8,067	36.0	23,905	12,838	73,338	884,511	38.9
Lake Central	40,626	6,668	38.2	13,115	30,836	23,309	704,666	39.8
Mohawk	90,915	18,242	45.0	27,698	33,285	50,089	1,848,388	44.1
North Central	85,006	15,588	42.1	43,448	55,709	84,045	1,664,046	44.0
Ozark	53,283	9,694	46.8	20,794	33,229	47,835	1,029,186	51.6
Pacific	35,742	8,305	48.5	18,990	5,703	9,700	827,615	49.5
Piedmont	32,836	10,023	49.3	15,692	23,759	33,642	1,032,009	51.3
Southern	37,189	6,716	36.4	25,099	19,920	30,267	718,800	38.7
Trans-Texas	30,814	7,106	37.5	22,054	12,984	50,884	765,951	38.6
West Coast	31,719	7,608	41.4	15,511	5,763	22,108	769,952	41.9
HAWAIIAN LINES								
Aloha	27,109	4,285	60.9	3,055	----	5,114	351,466	53.1
Hawaiian	36,123	5,356	57.2	4,600	----	154,976	589,210	58.3
CARGO LINES								
Aerovias Sud Americana	----	----	----	----	----	201,961	201,961	70.1
Flying Tiger	1,240	5,578	55.6	13,895	27,381	17,695,153	18,294,262	79.2
Riddle-Domestic	65	52	65.0	25,292	31,906	6,022,883	6,085,307	65.6
Overseas	6,852	43,220	91.4	5,732	1,593	926,692	5,255,987	86.3
Seaboard World	----	----	----	845,615	----	5,590,612	6,445,738	64.2
Slick	803	3,443	90.7	----	----	5,841,742	6,165,022	89.5
HELICOPTER LINES								
Chicago Helicopter	20,665	357	44.9	2,034	----	----	36,089	39.3
Los Angeles Airways	2,739	96	55.2	4,245	2,484	----	15,962	64.4
New York Airways	13,976	258	53.3	1,648	1,027	573	27,931	49.7
ALASKA LINES								
Alaska Airlines	7,867	6,586	34.3	70,537	3,120	850,393	1,591,224	62.2
Alaska Coastal	4,272	445	58.3	4,278	----	5,607	55,555	66.4
Cordova	2,000	266	45.4	5,526	----	30,795	63,946	57.5
Ellis	3,870	217	50.8	1,819	-----	2,482	26,624	62.3
Kodiak	776	49	44.1	478	----	886	6,348	49.7
Northern Consolidated	1,922	625	34.6	50,203	----	82,154	202,211	60.5
Pacific Northern	9,490	8,321	40.8	170,258	10,517	478,355	1,564,130	60.8
Reeve Aleutian	1,399	1,339	44.0	73,874	----	89,464	311,114	64.3
Western Alaska	611	30	45.0	2,786	----	2,565	6,222	53.0
Wien Alaska	3,105	714	31.0	57,271	----	123,521	254,890	52.1
Avalon	3,919	229	46.3	610	----	222	22,629	48.0

Compiled by AVIATION WEEK from airline reports to the Civil Aeronautics Board.



EL AL BOEING 707-420 transatlantic transport equipped with 17,500-lb.-thrust Rolls-Royce Conway bypass engines is being readied to board passengers at Tel Aviv's Lod Airport. An additional wing is being added to the small terminal building in rear to accommodate the increasing number of incoming passengers. Projected new and modernistic terminal is scheduled to be completed by 1965.

Report on El Al Israel Airlines—Part II:

El Al Aims at Across-the-Board Economy

By Cecil Brownlow

Tel Aviv—In addition to striving for high load factors, El Al Israel Airlines pays close attention to aircraft utilization rates in its constant battle to keep operating expenses at a level that permits the non-subsidized carrier to turn a profit.

Despite the carrier's respectable load factor record through most of the summer (AW Dec. 18, p. 39), El Al's managing director Gen. Efraim Ben-Arzi is firm in his belief that a good showing in this field alone is far from sufficient.

"I'm dead set," he says, "against those people who sit around comparing 2 or 3 figures out of 20.

"A company like ours, a relatively small one, must have a high utilization. We could fly once a week to New York with a 100% load factor and lose $20 million a year. . . . You have to compare load factors, utilization, per capita production, sales expense. . . . Unless you can keep sales expense within the proper framework, it will cost more than it's worth." Last year, El Al ranked third among the major airlines in per capita sales.

El Al's utilization figures for its aircraft have been good. Based upon a 365-day year rather than the 290-day calendar under which the airline must live, the 707 record averages out to approximately 9 hr. per day per aircraft; the Britannia's between 7.2 and 8.4 hr. each, with a high of up to 11.5 hr., according to Chief Engineer Chaim Pearlman. Before the arrival of the 707s, when the Britannia was being used over the Atlantic as well as to Europe and the Middle East, the latter aircraft's 365-day utilization averaged out to over 9 hr. per day.

Periods between overhauls for the 17,500-lb.-thrust Rolls-Royce Conway bypass engine used on the El Al 707s is now 1,400 hr. and will soon be boosted to 1,600 hr. The next, and Pearlman hopes relatively near, step will be to 1,700 hr. The 4,445 eshp. Bristol Siddeley Proteus turboprop powerplant for the Britannia has a present life of 1,700 hr. between overhaul, and El Al is now sampling to boost the figure to 2,000 hr.

The Conway overhauls are presently being carried out in England under contract, while major servicing of the Proteus is handled by the government-owned Israel Aircraft Industries located across the field of Tel Aviv's Lod Airport for El Al's administrative and engineering headquarters. The Conway overhauls probably also will be transferred eventually to IAI.

For the moment, however, the Conways due for overhaul are flown to London on regularly scheduled flights housed in the fifth pod installation designed by Boeing. A single technician accompanies the aircraft on the flight to aid in the pod's removal in London.

"We have the fifth pod installation and removal down to a fine art now," Pearlman says, "and it doesn't delay the schedule at all. . . . We had been told that we would get a 5% speed penalty with the pod, but actually it has been negligible."

Off-loading passengers, however, can sometimes be disturbed by the fast operation. "They see the pod being removed and think that the aircraft lost an engine."

Overhaul of the Boeing 720B's 18,000-lb.-thrust Pratt & Whitney JT3D-3 may cause some initial problems since, initially at least, they cannot be overhauled in Israel. El Al and other 720 customers are sharing in the cost of development of a fifth pod for the 3D by Boeing, but it will not be available by the time the first aircraft arrive, and initial spares will have to be delivered by other means. Overhaul agent has not yet been selected, but the task may be given to Pratt & Whitney since, once the fifth pod is developed, the engines could be flown to the U. S. on regularly scheduled New York flights.

El Al already is a member of the engine spares pool among Conway operators and will join a similar consortium for the JT3D. Five Conway spares are kept on hand and nine spare engines for the 720Bs will be purchased.

Airframe maintenance is carried out in El Al's expanding technical facilities at Lod on a progressive block basis, a system instituted here with the arrival of the Britannias, and as much of the major work as possible is scheduled for the relatively slack winter season.

The airline's on-time departure rate also has been "very good," according to Ben-Arzi. Average on-time departures for the Britannias and 707s was 79.3% in September, 83.5% in August, 81.4% in July and 80% in June.

Technical delays in September, Ben-Arzi says, totaled 37 hr., in August 78 hr. and in July, 65 hr. Commercial delays—holds on aircraft to await the arrival of connecting flights, etc.—consumed 10 hr. in July, ground handling and traffic control difficulties 5 hr. and weather only 68 min. Commercial delays amounted to 11 hr. in August, traffic control and ground handling delays to another 7½ hr. of the total overtime holds.

To remain healthy in an area of stiff competition and rapid technology, El Al has adopted a policy of fast amortization of equipment so that the carrier can be financially prepared to move quickly with the appearance of supersonic long-range transports.

The 707s, for instance, will be written off within seven years of delivery. Over 40% of the cost of the four Britannias already has been written off, and the two retired Constellations—for which El Al hopes to find a market—have been amortized completely. For this reason and others, El Al seems to fear the economic aspects of the supersonic aircraft less than some of its competitors.

In explaining the cost of buying in Israel as a matter of airline policy plus the necessity of exchanging its dollar receipts into Israeli pounds at the official rate, Ben-Arzi says:

"Take the smallest things, napkins for instance. If you buy them here at the approved prices, you pay a much dearer price than you would pay in, say, Amsterdam.

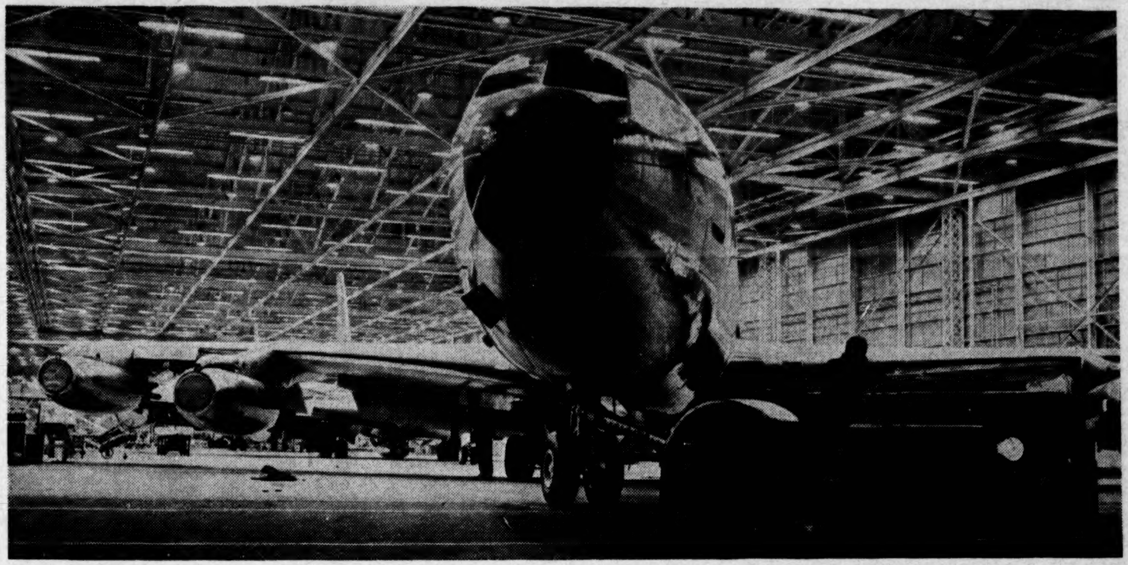
"On food, quite a lot is imported into Israel, but we don't import it. So we pay the imported price plus the duty plus the middle man. A first-class meal costs up to 14 pounds (about $8.40 at the official rate) when prepared here as opposed to 2 pounds ($1.20) in London, and this doesn't include service, drinks or linen."

For the supersonic transatlantic aircraft, Gen. Ben-Arzi agrees with U. S. proponents of a Mach 3 vehicle, declaring that "there's no point in going only to Mach 2 because the economic margin at this speed is not sufficient."

He doesn't believe, however, that a Mach 3 aircraft will be available by the early 1970s. "I have no doubt," he says, "that there will be a supersonic airliner. Once the engineers decided to do something, they will do it . . . but I think it will take a lot of time. . . . There are a number of problems still to be solved. . . .

"But it will come, and the traffic will grow, and I agree that there should be as much as a 50% increase in [ticket] price. . . . Some one in a hurry will pay $800 more to get there and back."

An El Al operations official agrees, saying that the advent of the supersonic transport will "revolutionize" the industry. With its arrival, he adds, "I don't believe there will be a need for first class, tourist or coach. There'll be just one class, and we won't need the large dinners and all the service that is necessary now."



707 IS ROLLED into new El Al maintenance hangar for a progressive block check between transatlantic schedules. Other maintenance facilities and shops now under construction in an El Al expansion program will be ready in February under present plans.

Deputy commercial director Menachem Cohen believes that any expanded route services to new European points or elsewhere, some of which are now being negotiated, may necessitate interim orders for aircraft "in line with the 707 or 720," but generally El Al plans to stick with its present generation of equipment "until another revolution" in design.

With the nation now firmly established, most El Al flight and maintenance crews are recruited from the ranks of former Israeli air force pilots and technicians and then put through a rigorous course at Lod. Present classes are instructed simultaneously on both the 707 and 720.

Cabin attendants are put through a training program which includes:

- **New trainees are sent** to work for one month in a luxury Israeli hotel. "The important thing," training manager Gideon Badash says, "is that it gives them more opportunity to breathe a good atmosphere. They see the proper way of handling wines and liquors and even such things as how to polish glasses."
- **Second step** is enrollment in a one-month Government Tourist Office special course to obtain "all the knowledge necessary about Israel." Two of the four weeks are spent visiting historical points of interest so that the attendants will be capable of discussing them knowledgeably.
- **Third step** is a full two months of lectures on the various types of tourists to expect, what their needs probably will be, the questions that can be expected and how to answer them.
- **Fourth and final step** is a one-month course of actual cabin training in Lod's 707 and Britannia mockups.

(This is the concluding article of a two-part report on El Al Israel Airlines. The first part appeared in Aviation Week Dec. 18, p. 38.)

El Al Growth—Fiscal 1956/57—1960/61

Equipment	1956/57	1957/58	1958/59	1959/60	1960/61
Boeing 707-420	....	....	....	....	2
Britannia	....	3	4	4	4
Constellation	4	4	4	4	4
Number of flights	863	984	1,278	1,637	2,019
Number of flight hours	11,862	12,180	13,840	14,639	17,065
Available ton miles (in thousands)	15,410	17,664	33,895	40,611	51,149
Ton miles utilized (in thousands)	9,885	11,487	19,013	25,010	30,969
Number of passengers	40,451	49,247	73,899	100,276	122,155
Passenger miles (in thousands)	84,527	99,282	168,236	220,551	269,862
Freight in tons	584	697	1,121	1,553	2,353
Excess baggage in tons	127	137	117	131	113
Mail in tons	145	206	207	220	257
Passenger load factor	61.9	63.4	55.8	61.2	60.9
Over-all load factor	64.1	65.0	56.1	61.6	60.5

AIRLINE OBSERVER

▶ Domestic trunkline coach revenue passenger miles in November rose 31% compared with the same month last year, but first-class traffic dropped 9%. Increase in all categories of traffic for the month was 11.2%. Load factors continued to fall—a drop of 5.15% to 51.5%—while available seat miles jumped 17%. Northeast showed the largest gain in coach traffic—66%. Only Delta, National and Northwest reported increases in first-class traffic. Highest load factor was American's 57.5%. Six carriers had load factors below the 50% mark.

▶ National and Continental are optimistic over chances of the Civil Aeronautics Board approving their proposed merger (AW Dec. 18, p. 35). Both carriers also hold high hopes of linking New York with Chicago as part of the over-all route structure. This is based on fact that the United-Capital merger left no competition between Chicago-Cleveland and Cleveland-New York. Eastern is expected to be the only serious opponent to the merger. Long-term objective appears to be to bring Northwest Airlines in the group, but because of the vigorous opposition the move would stir, the plan is not being pushed.

▶ Commerce Department will form a government-industry advisory committee on civil aircraft values to make a study of the airlift potential of aircraft operated by airlines and to develop a uniform pricing formula that can be used for Civil Reserve Air Fleet, War Air Service Pattern and Aviation War Risk Insurance.

▶ High percentage of airline pilots are opposing the Feinsinger report because they feel it fails to require a sufficient amount of training for flight engineers and copilots. Last year, pilots made several attempts to persuade E. R. Quesada, then administrator of the Federal Aviation Agency, to expand training requirements for the two groups.

▶ Growing breach between Soviet Union and Red China has resulted in a sharp decline in air traffic between the two countries. Aeroflot's schedules between Peiping and Moscow have been cut to two Tu-104 flights per week, and these reportedly are operating almost empty. Only other known air service connecting the two countries is a Chinese-operated service between Peiping and Irkutsk on a once-a-week schedule.

▶ Mexican airline pilots are seriously contemplating grounding all flights during darkness and instrument weather as a means of forcing the government to install navigation aids on airline routes into Mexico City. Pilots have been told lack of funds prevents installation of aids. Pilots charge that insufficient ILS, VOR and air traffic control centers are endangering airline operations on these routes (AW Oct. 30, p. 47).

▶ Watch for Lockheed-Georgia Co. to accelerate production of C-130 series four-turboprop transports from a current roll-out rate of about three per month to about 10 per month during the first quarter of 1962. New schedules reflect the top priority accorded rapid-response airlift by the U. S. and its allies.

▶ American Airlines and Boeing Co. have asked the Civil Aeronautics Board for authority that would permit the airline to sell to the manufacturer 10 Boeing 720-023 turbofan transports. Boeing would pay American between $3.1 and $3.5 million for each aircraft. The sale is tied in with the purchase of 25 Boeing 727 transports to be delivered to American during 1964. The 720s will be delivered to Boeing on a one-for-one basis as the last 10 727s become available. The agreement has a clause that will permit the delivery of the 10 720s to coincide with delivery of the sixth through 15th 727, if deemed desirable.

▶ Continental-National merger proposal could cause a fresh eruption of the crew complement issue between the Air Line Pilots Assn. and the Flight Engineers International Assn. Continental engineers are pilot-qualified members of ALPA. National flight engineers, who recently signed a two year contract, are FEIA members who hold airframe and powerplant ratings.

SHORTLINES

▶ **Air Transport Assn.** reports interline business conducted by U. S. certificated air carriers totaled $85.8 million in October, compared with $85.2 million in October, 1960.

▶ **Delta Air Lines** has Civil Aeronautics Board permission to suspend service to Havana until further notice. Delta's Panama traffic has dropped from a peak of 40,125 passengers in 1957 to 3,479 for the first 11 months of 1961.

▶ **Eastern Air Lines** reported it was prepared to operate up to 208 extra jet flights to Florida and 42 to Puerto Rico for the holiday travel rush. Extra flights will operate until Jan. 5.

▶ **Lake Central Airlines** reports that as of Jan. 16 it will serve Chicago through O'Hare International Airport instead of Midway, but will continue its ticketing services at Midway. The airline said it made the move to provide better connections with transcontinental and international flights.

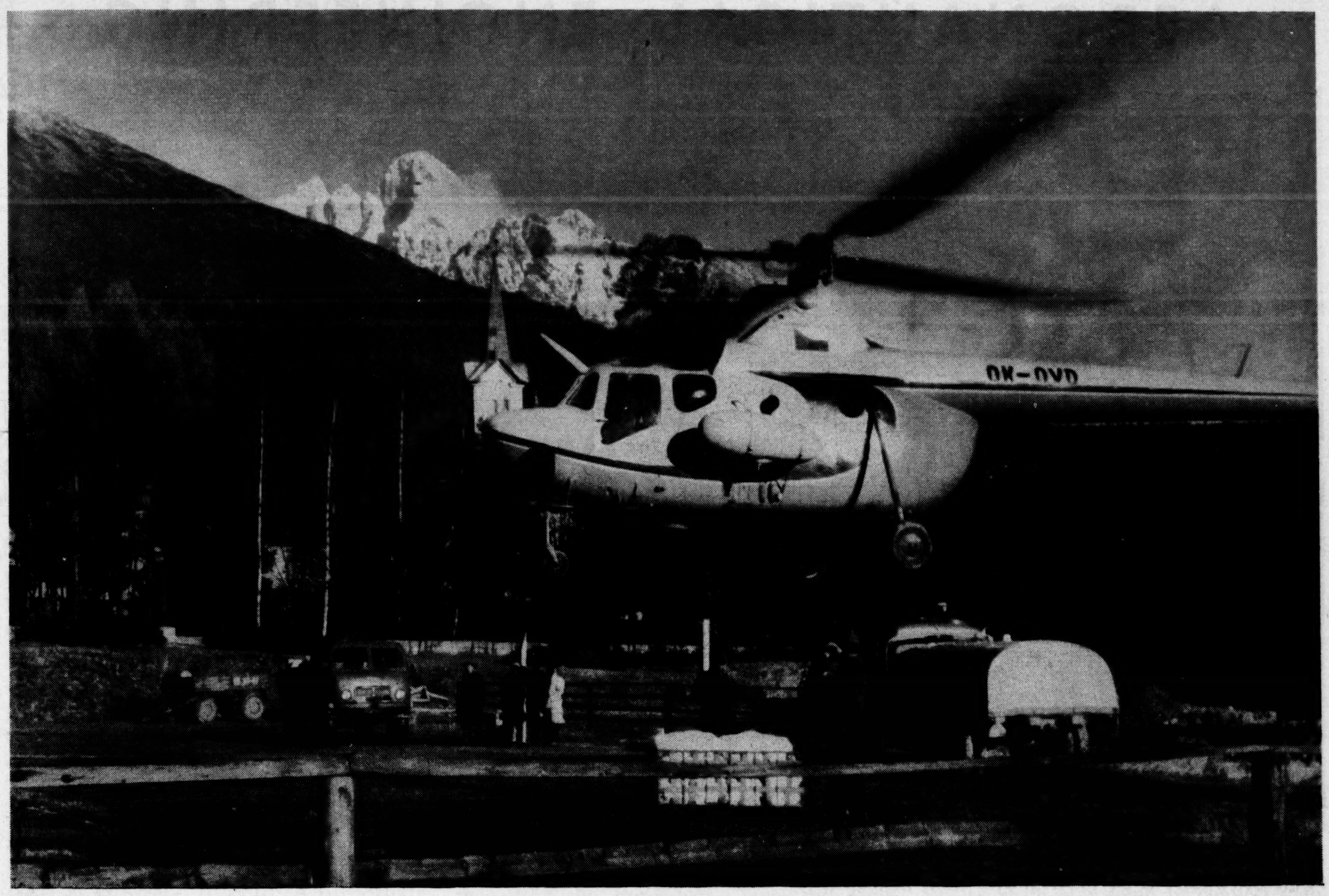
▶ **Northwest Airlines** has asked CAB to remove a restriction prohibiting it from carrying local passengers between Tampa-St. Petersburg-Clearwater and Ft. Lauderdale, Fla. on its four daily flights between Midwest points and Miami. Northwest said it was seeking the authority because Mackey Airlines reduced service among these points on Dec. 1.

▶ **Pan American Airways** reports two new lightweight fiberboard containers have been developed for its freight preloading system. The containers have cubic capacities of 58 and 18 sq. ft., and their use can reduce the 1,000 pieces of an average cargo load to 28 and 112 pieces respectiviely.

▶ **Trans Caribbean Airways** has ordered its second DC-8 from Douglas Aircraft Co. The aircraft is scheduled for delivery in time to begin operations next summer. Trans Caribbean received its first DC-8 in November.

▶ **Trans World Airlines** is equipping its jet fleet with engine vibration monitors to detect early signs of engine malfunction. The $338,000 program is scheduled for completion during 1962.

▶ **Western Air Lines** has CAB permission to suspend service between Calgary and Edmonton, Alberta, Canada after experiencing declining load factors during the past two and one-half years. Suspension will be effective between Jan. 1, and June 15, 1962.

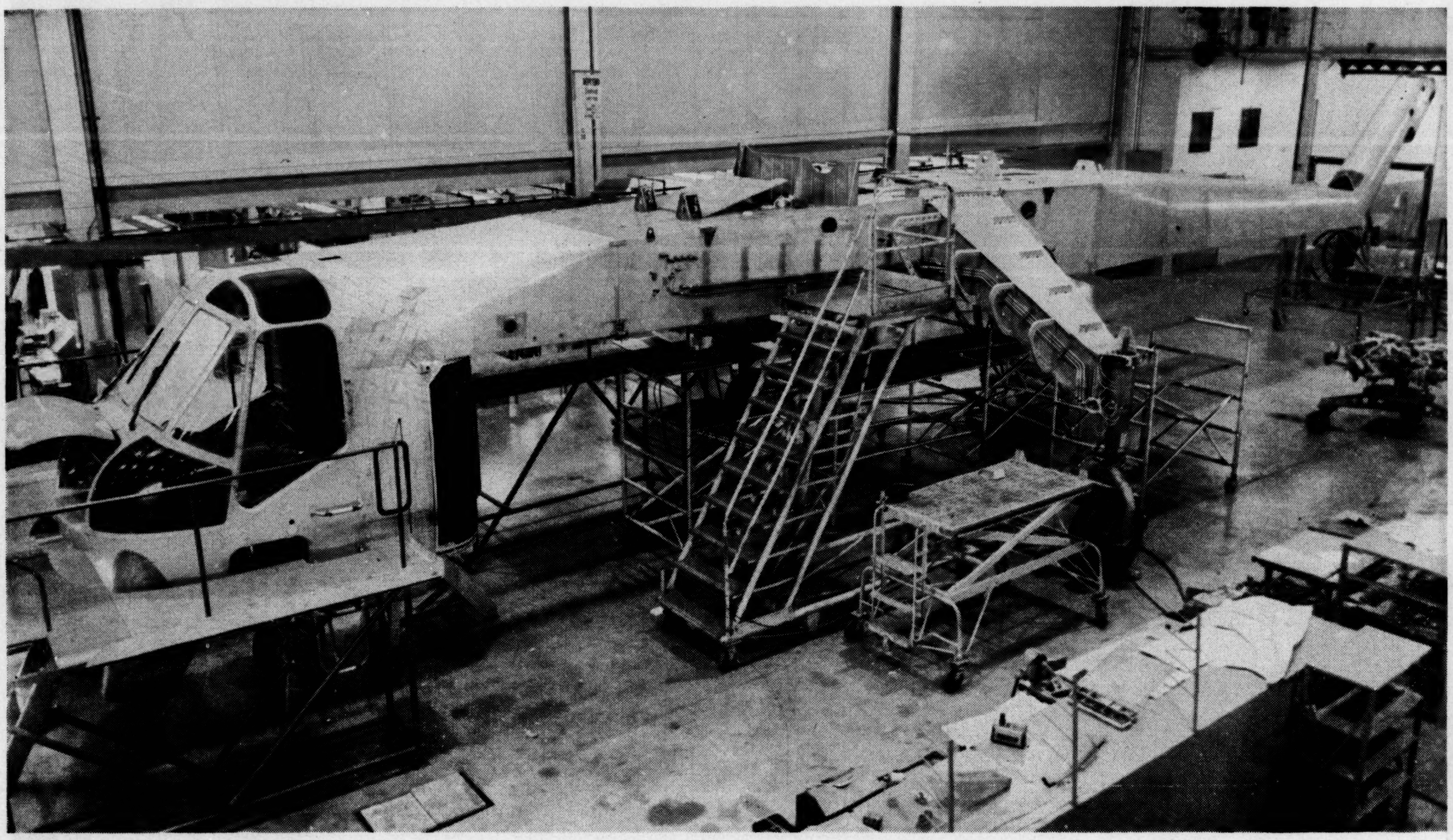


CSA Czechoslovak Airlines, which operates a fleet of small aircraft for air taxi and multi-purpose activities in addition to its scheduled flights (AW Nov. 13, p. 48) is now extending its duties to include helicopter charter services. Several Mi-1 and Mi-4 helicopters went into service with the carrier this summer. In November, they were operated for the first time for the transport of heavy material. Mi-1's four-cable hoist (above) is fastened to the load prior to takeoff on its flight into the Tatra region. Note extra fuel tank on fuselage.

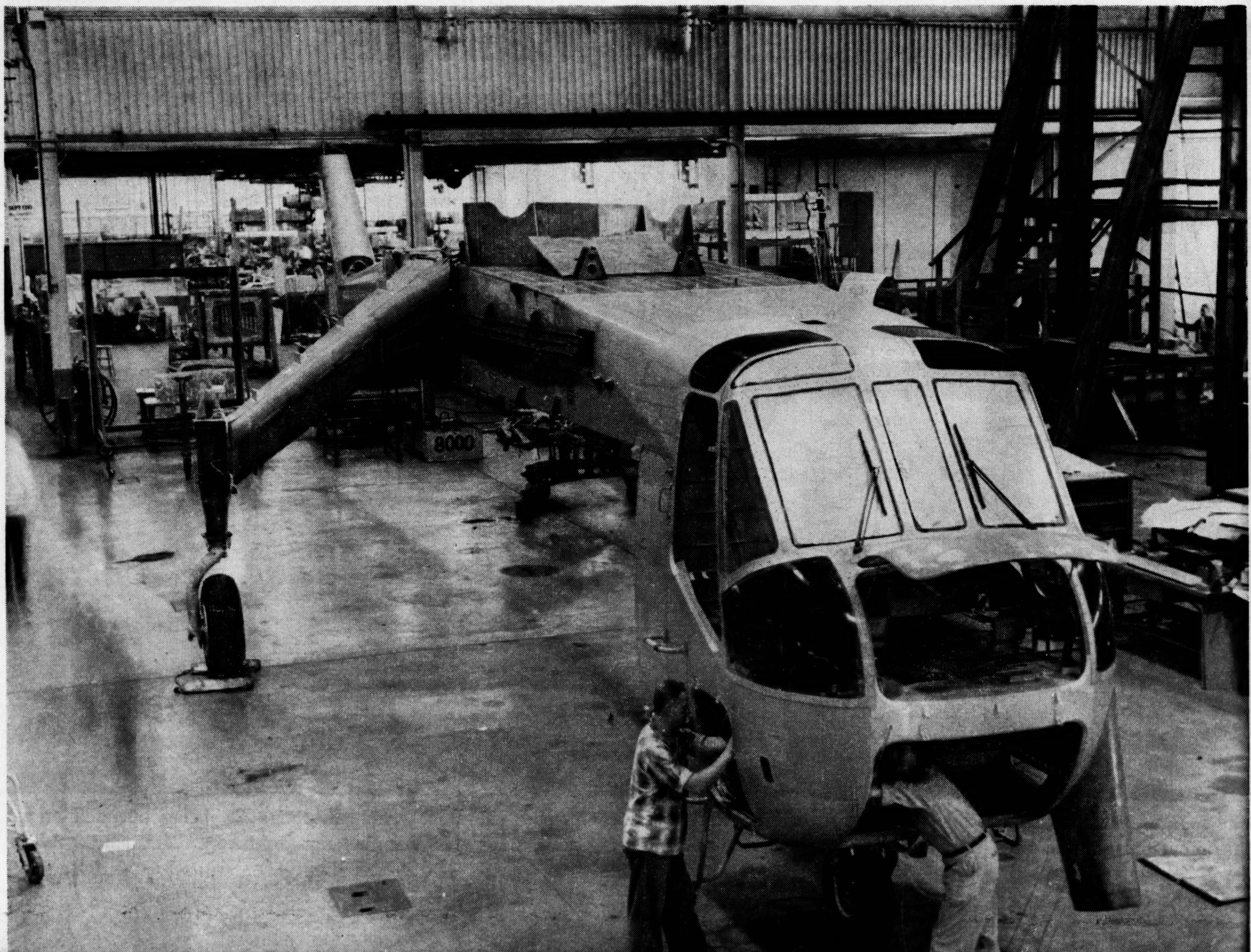
Czechoslovak Airlines Adds Helicopters to Service

Mi-4 helicopter is shown hovering over Czech coal pit while workmen prepare the load. The helicopters are being operated on an experimental basis for the transportation of various supplies ranging from heavy building materials to food.

AERONAUTICAL ENGINEERING

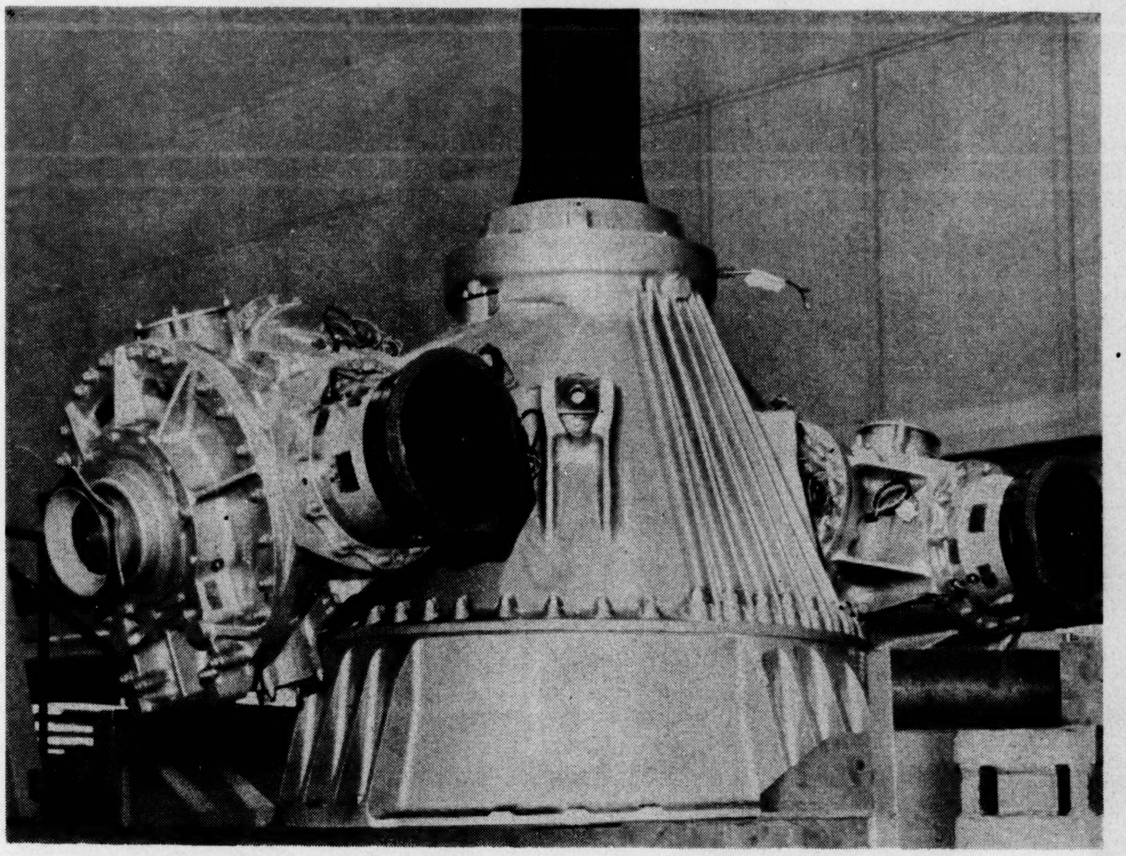


FIRST SIKORSKY S-64 TRANSPORT crane helicopter for West Germany nears completion on final assembly floor of prototype shop. Powered by paired P&WA JFTD-12A turboshaft engines, the S-64 is essentially a lifting machine which can carry a variety of loads externally or in detachable pods. Structure is designed for easy maintenance; entire upper deck of fuselage is walkway area. Hydraulic lines, electrical wiring, and control pushrods run externally along the fuselage sides. Plastic sleeve extending from left-hand side of cockpit is radar altimeter for test flights only.

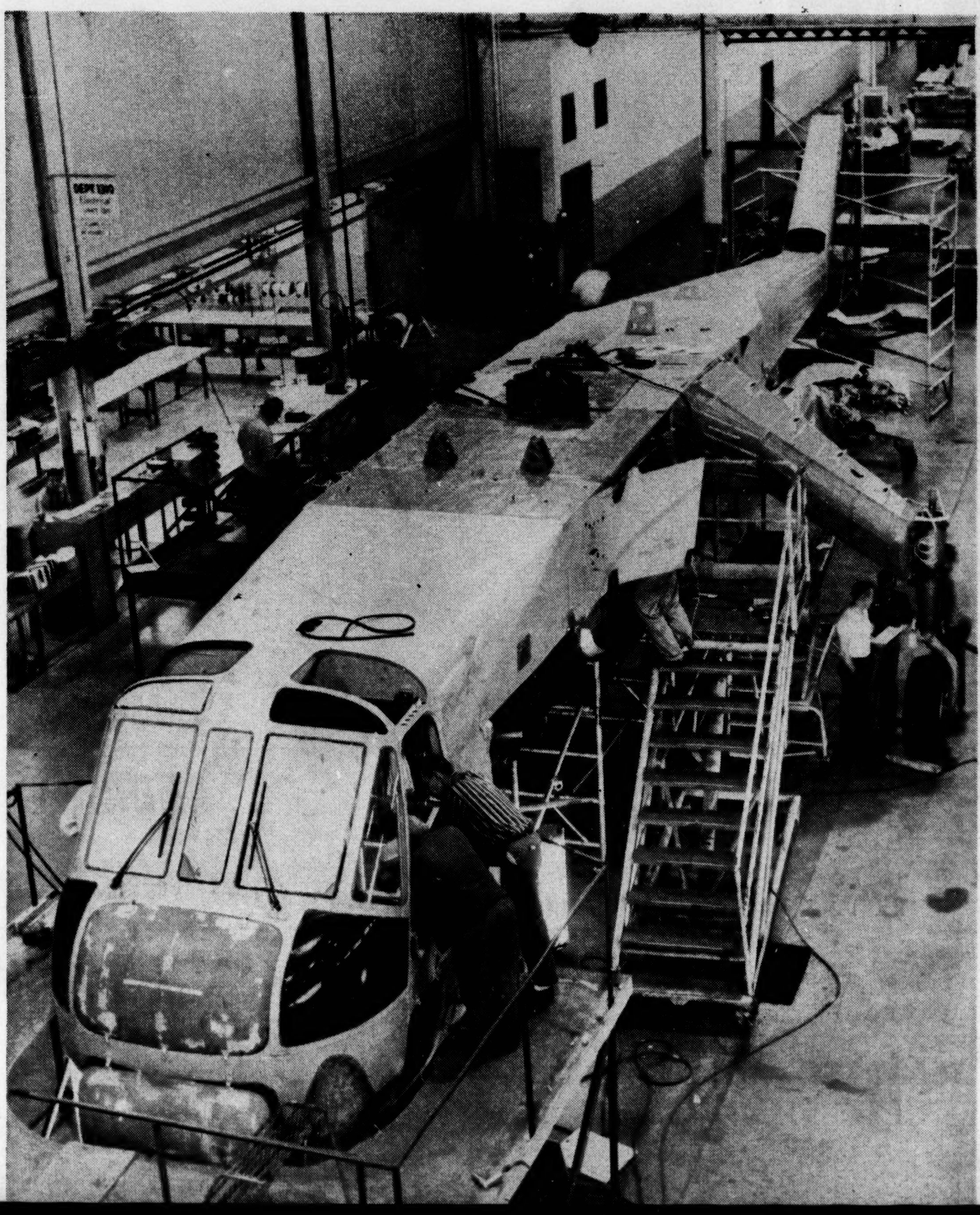


Sikorsky S-64 Can Lift Up to Nine Tons

By David A. Anderton



TRANSMISSION BOX (above) for S-64 is biggest built by Sikorsky so far, will handle more than 8,000 shp. through two input stub shafts. Smaller shaft ends could be connected to auxiliary propulsion system on stub wings. Below, Sikorsky mechanics complete installation of system and airframe components.



Stratford, Conn. – Sikorsky Aircraft S-64, designed as an all-purpose transport and flying crane, is about ready to be rolled out of the factory here for the start of ground tests.

Six months of flight testing will follow, ending sometime in autumn of 1962. First delivery of an S-64 to West Germany, currently the only customer, is scheduled for the end of 1962.

Basic idea behind the design of the S-64 was to produce a rugged prime mover that would be to air transportation what the trailer truck is to over-the-road transportation. To achieve this goal, Sikorsky designers used or developed as many existing components as possible. They drew on extensive demonstration experience with the piston-engine powered S-60 crane helicopter. They designed to a specification drawn up by the West German air force. And they combined these factors in an airframe which is powered by a pair of Pratt & Whitney JFTD-12A turboshaft engines and which is calculated to be able to lift almost 55% of its own gross weight as payload.

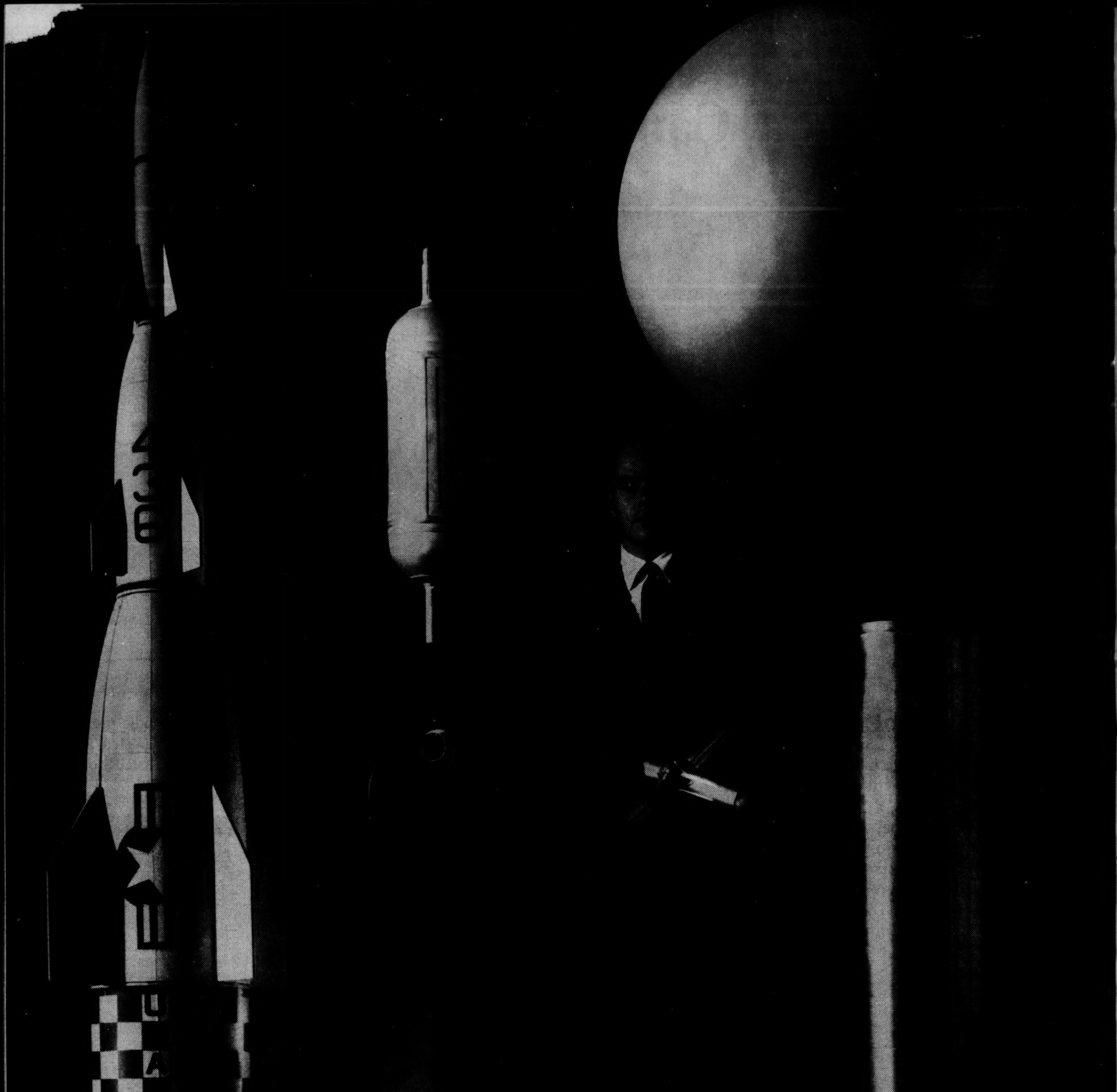
Performance guarantees show the S-64 will carry 60 fully equipped troops a distance of 100 naut. mi. It will haul an externally slung, six-ton payload for 200 naut. mi., an eight-ton load for 100 naut. mi., or a nine-ton cargo for a distance of 50 naut. mi. These figures are based on a sea-level standard day atmosphere and include a 10% fuel reserve.

Crane Concept

The S-64 is a twin-engine lifting system with a widespread main landing gear that can straddle a variety of load shapes and sizes, including a series of faired pods designed to hold cargo, people or specialized installations.

The high fuselage, whose flat and level bottom is 112 in. above the ground, carries a six-bladed main rotor system, with a four-bladed tail rotor perched high on an inclined boom at one end and a five-man cabin slung under the other end.

This ungainly looking combination can lift nearly 21,000 lb. or tow with up to 30,000 lb. of towline tension, enough to salvage heavy vehicles on land or ships at sea. Sikorsky's Walter W. Lysak, senior project engineer on the S-64, says that the abilities of the transport/crane are limited only by its capacity and the imagination of the user. Among other ideas described for the S-64 as a military vehicle are its use as a resupply system to haul fuel tanks or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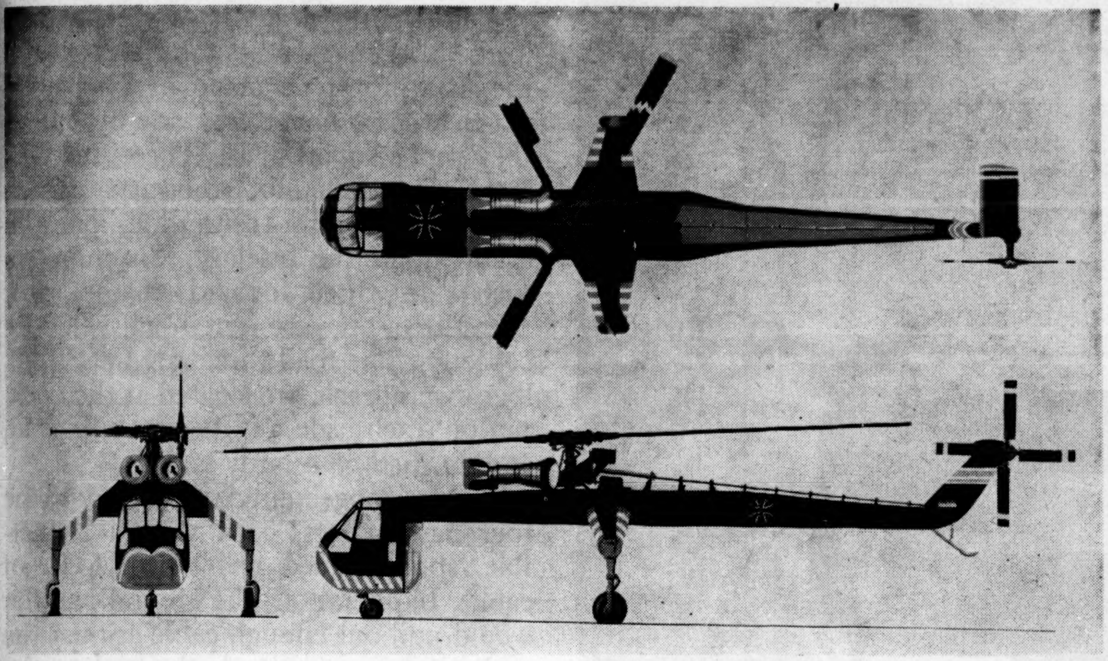


THREE-VIEW DRAWING of Sikorsky S-64 in markings of West German air force shows the general arrangement of the transport/crane helicopter. Tail skid retracts to permit rear loading and unloading of wheeled pods or cargo.

water to forward combat areas, and to carry missiles, weapons and their supporting power packages or small maintenance shops to field firing points. As a cargo transport, the S-64 can fly in with a loaded pod, and exchange it for an empty one without waiting for the unloading and loading cycle to be completed.

Finally, the pods can be tailored for specific missions. Internal arrangements for anti-submarine warfare equipment or for minesweeping can be installed in separate pods, ready for use as needed.

In the civil aviation field, an S-64 could be used to pick up passengers, who have already boarded the "people pod," at the downtown airline terminal and fly them out to the increasingly remote jet airports now under discussion or planning. After arrival and detachment of the pod, which could be towed by tractor directly to the airplane for boarding, the S-64 could strap on a pod of passengers waiting to go downtown and deliver them to their destination.

Lifting System

Power and lift for the S-64 are supplied by a pair of Pratt & Whitney JFTD-12A turboshaft engines rated at 4,050 military shaft horsepower each, driving a six-bladed main rotor and a four-bladed tail rotor. The main rotor zero-lift plane is tilted forward and to the left by three degrees in each direction. The forward tilt is to keep the fuselage more nearly level in cruise flight; the lateral tilt is to keep the wheels level during hovering.

Many of the components of the rotor system came directly from the Sikorsky S-56 (Army H-37A, Navy and Marines HR2S-1) twin-engine helicopter. The main rotor and tail rotor blades, the main flapping and drag hinges, the tail rotor head, gear box and intermediate gear box, and the main rotor servo all came unchanged from the S-56. Rotor head design is like that of the S-56, except that there are six attachments to the rotor hub instead of the five of the earlier machine.

Reason for the increased number of blades is to increase rotor solidity (ratio of total blade area to swept disk area). This in turn means a reduced blade loading (flight weight divided by total blade area) and therefore a smaller blade chord.

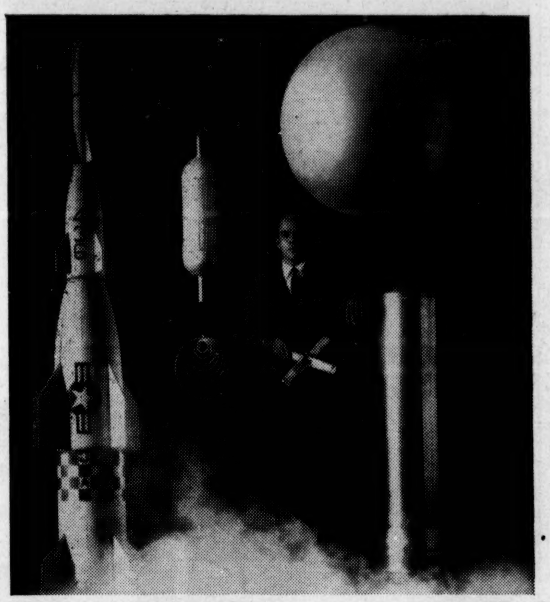
With the smaller chord, the shift in the aerodynamic center is decreased as the blade sweeps through a complete rotation. This reduces the variations in blade torque fed to the root fittings; those torques causing a large share of helicopter vibration. Consequently, the aerodynamic vibration level of the S-64 should be lower than that of the S-56.

Main rotor blade airfoil is a symmetrical NACA 0012 section. Blades are constant-chord with the usual spanwise twist distribution.

Below the main rotor is the transmission gear box, a huge truncated cone with the main rotor shaft protruding from the top and paired power takeoffs angling off the sides. Both engines couple to input stub shafts at the forward end of the transmission. There are also lateral power takeoffs which could be adapted for propulsion by using them to drive outboard propellers through suitable shafting and gearing.

Four main fuel cells, two ahead of, and two behind the main rotor, house 5,800 lb. of JP-4 fuel in the S-64 structure. There is further provision for additional fuel space of 2,900 lb., equally divided between one tank ahead of, and one behind the others. Fuel load under those conditions would be 8,700 lb.

The fuselage, or boom as most of the Sikorsky engineers call it, is a pure shell structure with a couple of heavy transverse bulk-heads to take the landing



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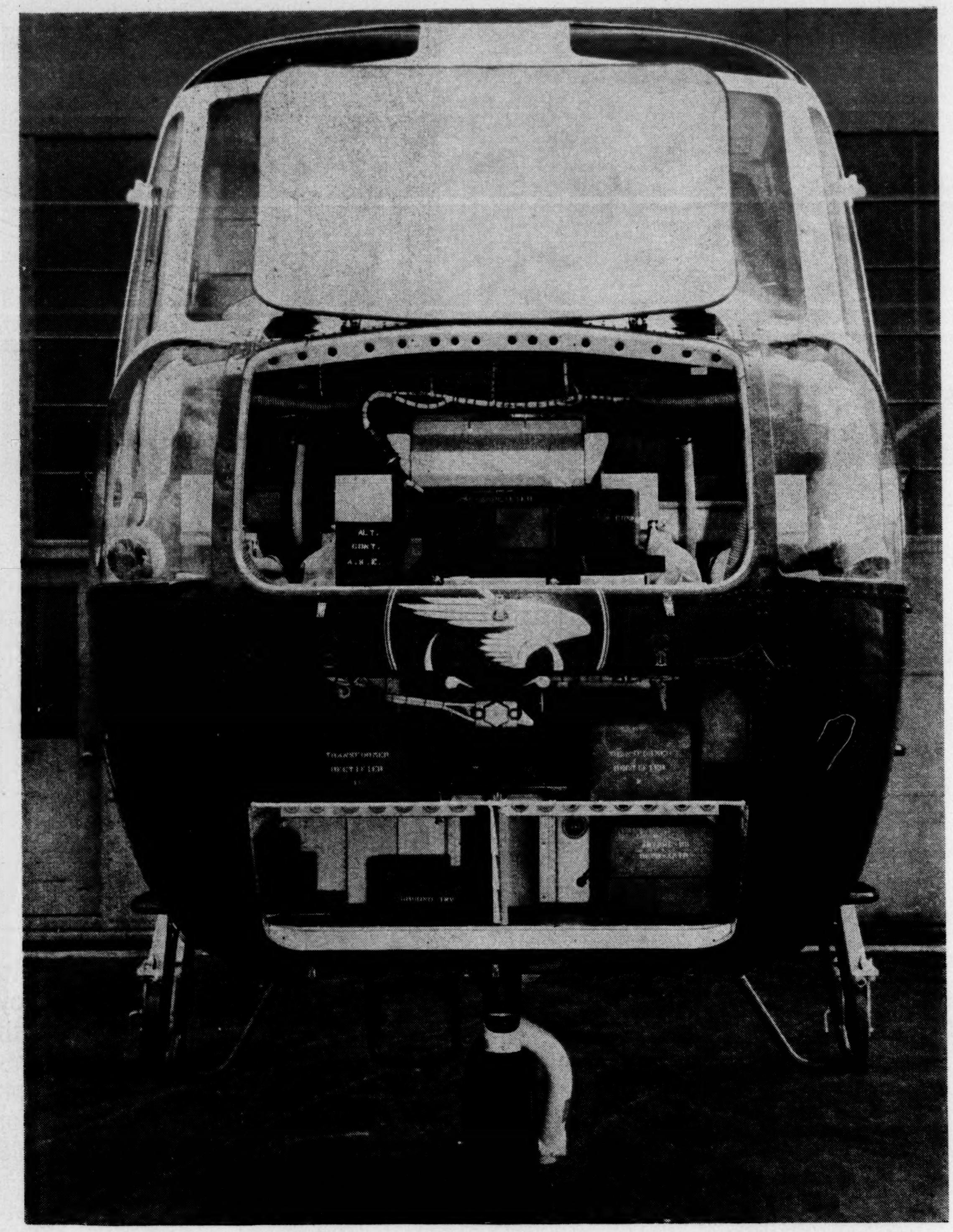


SIKORSKY S-64 COCKPIT mockup shows installation of electronic system components in nose compartments. Hinged doors lift up on both bays for easy access. Lower bay can be reached by mechanic standing on ground; upper requires stepstool.

gear. There are bolted connections at the production breaks, one just aft of the cabin and the other in the tail section. The landing gear also attaches with bolts.

The entire top deck of this slab-sided box structure is a walk area for maintenance; access steps are built in on the landing gear and the landing-gear beam. In addition to the powerplants and rotor systems, the top of the boom carries the major hydraulic system components in a solid trapezoidal box on the port side just aft of the main rotor.

All hydraulic lines, wiring and control pushrods run along the outside of the boom for easy maintenance. The cargo winch is installed in a bay directly underneath the main rotor transmission and flush with the bottom of the fuselage. Aircraft heating system is installed ahead of the fuel cells in the boom.

Major factor in the choice of materials for the structural components was to get the lightest structure that would handle the effects of both elevated temperatures and fatigue in addition to providing the required static strength. At best, the structure near the powerplants will become heat-soaked, regardless of heat barriers used in the layout, and the expected stabilization temperature was pegged at 250F.

Basic Materials

Basic materials investigated were 2024 and 7075 aluminum alloys; the comparison of long-time, high-temperature strength worked in favor of the 2024 alloy, which was therefore chosen for primary structure adjacent to the powerplants.

It also was used in critical fatigue areas of the structure, not necessarily because it was the best choice, but because there is the most extensive fatigue experience available with the material.

The drive shaft to the tail rotor has multiple bearings, each riding in a fluid-filled "rubber tire" fitting so that the shaft can seek its own neutral position.

The "hard" points, to which cargo loads can be secured, are located on the first prototype crane in 17 places, which will be eliminated one by one as they prove superfluous. There are two, rated at 10,000-lb. capacity, which straddle the rotor centerline, one on each side of the fuselage. Six more on each side, three forward of the rotor and three aft, are rated at 5,000-lb. capacity. The final three rated at 3,000-lb. capacity each, are located at the cockpit on each side of its aft bulkhead, and on the boom fairly far aft.

Final arrangement is expected to be four hard points, each with a retractible, spring-loaded reel with 16 ft. of cable. In operation, the ground handler would pull out enough cable against the spring takeup to attach the end to the load. Takeup would tighten the cable, the pilot would lock each reel. Unsymmetrical loads can be handled this way as easily as symmetrical ones.

Each of these four reels can be retracted to even up the cargo, or to get another eight inches of ground clearance if circumstances demand and permit a running takeoff for overload conditions. The hydraulic retracting cylinders also act as viscous dampers to isolate the load from vibration.

An additional feature of the S-64 that is aimed at simplifying its crane operation is the kneeling landing gear. By pumping hydraulic fluid in or out of the main gear cylinders, the whole aircraft can be raised and lowered by eight inches. The crane can then straddle a pallet, lower itself by eight inches, secure the pallet and stretch its legs to their full operational height to give the load ground clearance. This is in addition to the eight inches provided by the cable reel retraction.

The eight-inch motion of the gear pays a dividend as a safety factor in a hard landing. There is a hydraulic fuse in the landing gear circuits so that if the sink rate is higher than the design figure, the fuse breaks. This allows the remaining eight inches of gear travel to be used to absorb the extra energy of the hard landing.

The tail skid, which is positioned to keep the tail rotor from striking the ground during nose-high landings, retracts up out of the way as soon as there is weight on the landing gear.

Leading and trailing edges of the landing gear inclined beams are closed with glass fiber fairings. The final shape of the faired section is that of a very thick airfoil with a large trailing-edge camber. The strange shape was chosen to give a zero-lift airfoil in the normal nosedown cruise attitude of the S-64.

An auxiliary gas turbine power unit, the tiny German BMW 6012 powerplant, is used to furnish aircraft electrical and hydraulic power when the rotors are not turning. Thus the S-64 can be self-sufficient at a remote point where there is no auxiliary ground power equipment.

Pilot and copilot positions are designed in a conventional manner, with one exception: the copilot's seat, which has much more freedom to move than the pilot's. The reason for this is that the copilot takes over as crane operator from a rear-facing seat two steps down and behind the normal copilot position. He must be able to get to and from that seat freely and easily.

Both pilot's seats tilt back 30 deg.; this is for more comfort when the helicopter is towing something and assumes a nose-down attitude.

The pilot's position—on the right of the cockpit, which is conventional for helicopters—faces the standard instrumentation layout. Cyclic stick is floor-mounted between his legs and the collective stick is at his left. The collective stick is topped by a miniature console with eight functional switches.

Engine instrumentation is mounted between the two pilots' panels; a console between the pilots carries the avionics, hook and hoist controls and indicators and other auxiliary services.

Electrical Controls

All engine controls from the cockpit to the powerplants are electrical. Electro-mechanical actuators mounted on the engines respond to cockpit signals transmitted by wire.

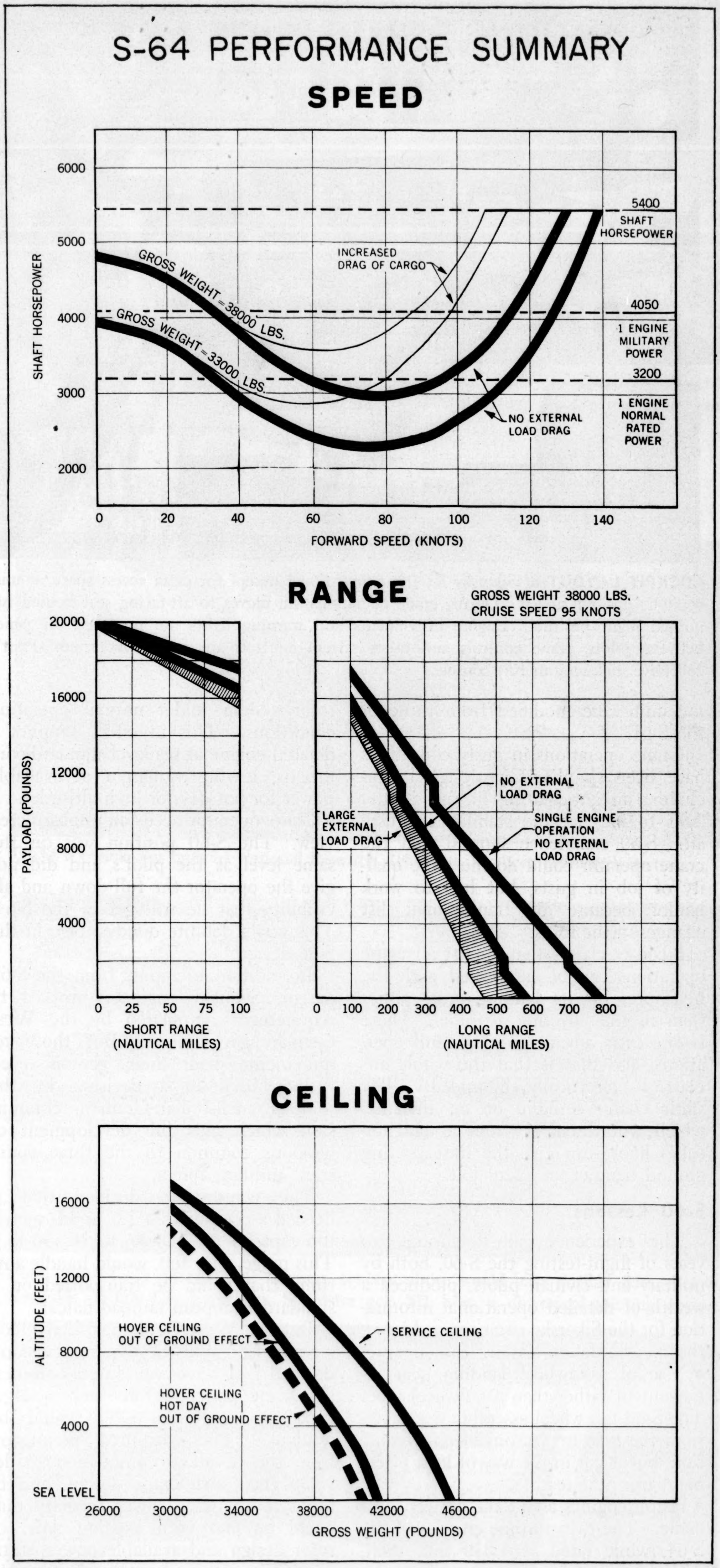
For crane operations, the copilot takes the aft-facing seat at the rear of the cabin. This position has conventional helicopter controls also, with the exception that the cyclic pitch control is on the right-hand armrest of this seat to give the copilot better visibility of the crane area.

Experience with the S-60, which had a similar rear-facing crane operator's position, showed that the copilot had clear vision of the operation, even in snow or dusty ground conditions. The upflow from the rotor downwash stays forward of this area in hovering near the ground.

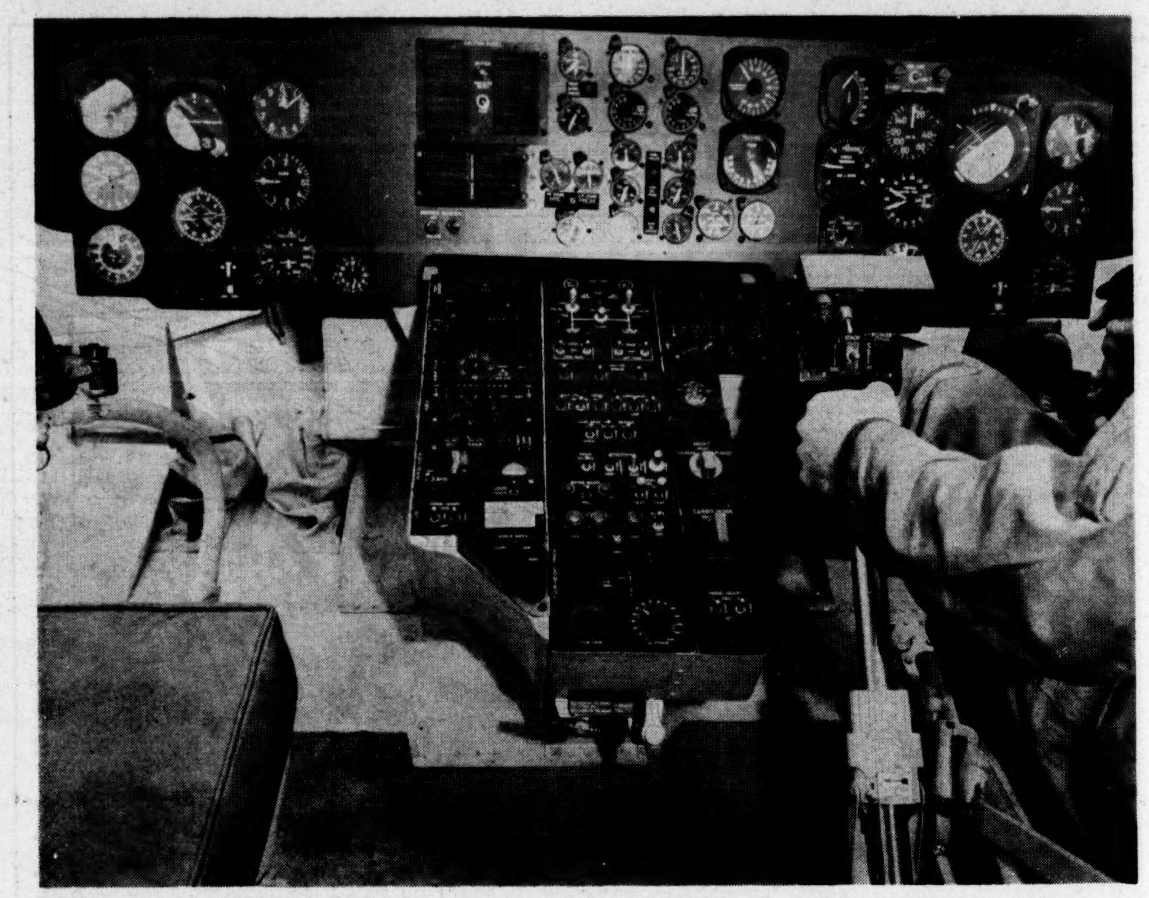
For a typical crane operation, the pilot positions the S-64 in the air and the copilot takes over from the rear seat for the let down. He retains that control through the off-loading or loading sequences, and only relinquishes control to the pilot after the helicopter has cleared the immediate area.

Sikorsky's Automatic Stabilization Equipment (ASE) is installed; its auxiliary servo system, which can be thought of as the muscles of ASE, is adapted directly from the S-62 design. There is a standby circuit in the copilot's electric stick at the crane operator's position; this circuit runs directly to the servo valves, bypassing the ASE system.

Cockpit controls and the control mix-



THREE GRAPHS above plot the performance summary of Sikorsky S-64 transport/crane.



COCKPIT LAYOUT of Sikorsky S-64 is conventional except for extra access space around copilot's position at left. During crane operations, he moves to aft-facing seat behind his normal flight position. Engine instruments and warning lights are mounted on panel between pilots; crane controls and other system controls are console-mounted. Pilot's collective stick mounts tiny console.

ing unit were modified from those of the S-61.

Crane operations in gusty conditions have been simplified in design by including an anticipating linkage in the ASE to increase the stability in gusty air. S-60 experience showed that the crane operator could do the same quality of job in gusts, but had to work harder because of translational lift changes in the rotor.

Sikorsky claims that almost all crane operations can be performed with the helicopter on its landing gear, rather than in the hovering attitude. There is one extra advantage of ground operations, and that is that the whole aircraft is electrically grounded. The static charge buildup on an airframe, which will discharge from a dangling cargo hook, can give the unsuspecting ground handler an awful jolt.

S-60 Lessons

The experience gained during two years of flight-testing the S-60, both by military and civilian pilots, produced a wealth of detailed operational information for the Sikorsky engineers. Among the specific design lessons learned were:

- **Use of nosewheel landing gear** arrangement rather than a tailwheel type. The S-60 tail wheel assembly was taken from the S-56 for reasons of cost reduction, but it got in the way of load placement from the rear.
- **Piston engines aren't the answer** for a crane. The twin turbine engines of the S-64, while rated at 4,050 shp. each, do not have to deliver that much to the rotor system under normal operating conditions. This in effect supplies a derated engine at sea-level standard conditions, leaving a margin of available power for hot days or high altitudes.
- **Crane operator needs an unobstructed** view. The S-60 position was on the same level as the pilot's and did not give the operator the full down and aft visibility that he will get in the S-64. This was a definite disadvantage in the S-60 design.

In addition to inputs from the S-60 design, Sikorsky engineers worked to requirements stipulated by the West German government. But those requirements had their genesis even further back in a decision by the joint French-Italian-German commission which aids the development of weapons common to the three countries' military forces.

The commission decided that it needed a crane with a 12- to 14- metric ton capacity (26,450 lb. to 30,850 lb.). This range, they felt, would handle anything that could be transported on a standard European railroad flatcar.

But the West German military took a realistic view of the requirements and decided that there would be a considerable time period before such a large-capacity crane helicopter would be available. They acquired permission from the tri-lateral commission to develop their own crane design, and to build it around a lower capacity that could be met with existing types of rotor design and available powerplants. The German view was that this would provide them with a relatively inexpensive means of evaluating the entire idea of a turbine-powered crane before committing extensive funds to a development program.

The resulting competition was entered by Sikorsky, France's Sud Aviation and Italy's G. Agusta s. C. A. Sud's entry was based on its Frelon.

In the evaluation that followed, the Germans chose the Sikorsky S-64 design and ordered two units. The company is building a third as a demonstrator and prototype test vehicle.

Current Status

Current status of the program finds the first aircraft for Germany on the final assembly line, with detailed installations being made and scheduled for rollout by the end of the year. All components will have completed their test program by that time, also.

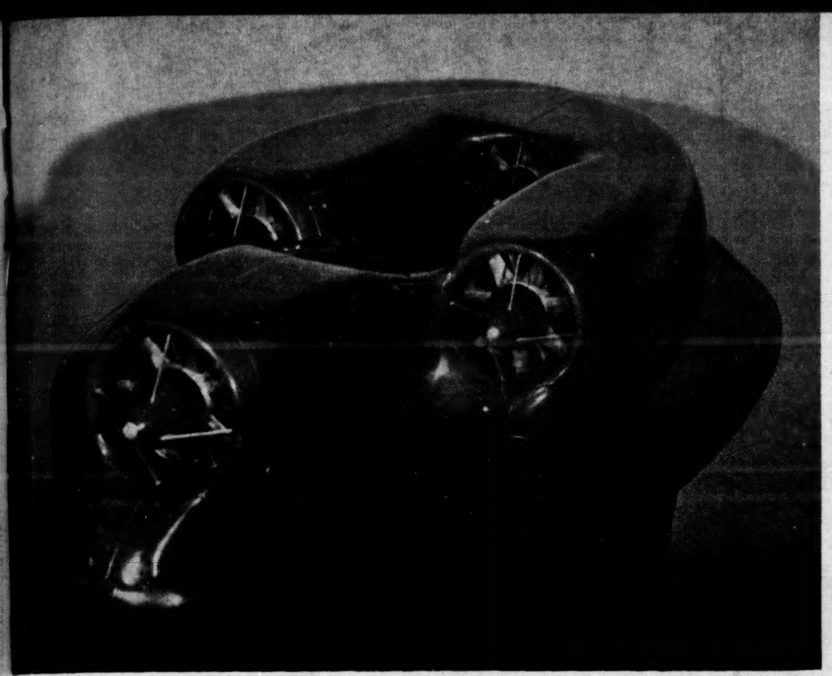
The rotor system and the entire dynamic system, which started tests in July this year, will continue to run under test until sometime in 1962.

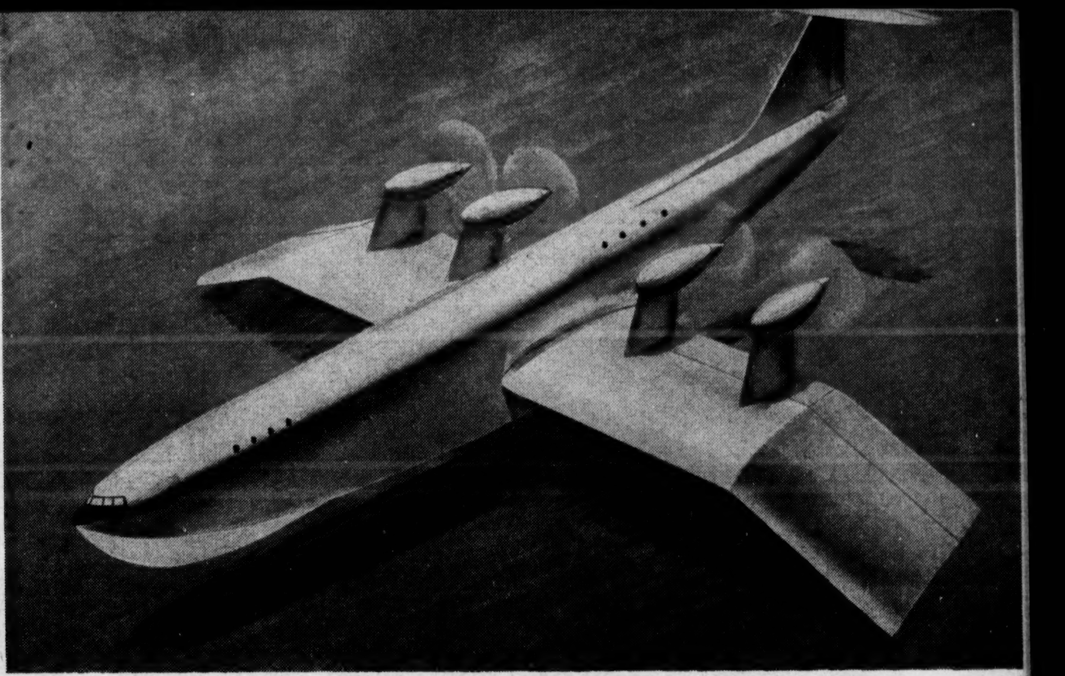
Sikorsky S-64

Basic Characteristics

Dimensions:	
Main rotor dia.	72 ft.
Tail rotor dia	15 ft.
Over-all length with blades extended	87 ft. 6 in.
Over-all height at main rotor	18 ft. 7 in.
Over-all width, blades folded	21 ft. 10 in.
Wheelbase	24 ft. 5 in.
Wheel tread	19 ft. 9 in.
Ground clearance	9 ft. 4 in.
Weights:	
Gross weight	38,000 lb.
Useful load	20,760 lb.
Performance:	
Maximum speed at sea level with faired pod	145 kt.
Maximum speed at sea level with external load drag of 12 sq. m. (129 sq. ft.)	102 kt.
Cruise speed at sea level with external load drag of 12 sq. m. (129 sq. ft.)	95 kt.
Vertical rate of climb at sea level	800 fpm.
Hover ceiling, out of ground effect	6,000 ft.
Maximum range, both engines	600 naut. mi.
Maximum range, single-engine cruise	800 naut. mi.

Conditions: Performance guarantees are based on sea-level standard day conditions, a crew of two plus three passengers, and a 10% fuel reserve.





Navy's David Taylor Model Basin built 8 ft. x 3½ ft. model at left and conducted series of wind tunnel tests of its stability. Electric motors power model for free flight tests. Facility's concept of wing-in-ground-effect seaplane is at right. Navy aerodynamicists are conducting wind tunnel tests on wings like this. Feasibility hinges on slow speed capability and stability.

Military and Civil Ground Effect Designs Tested

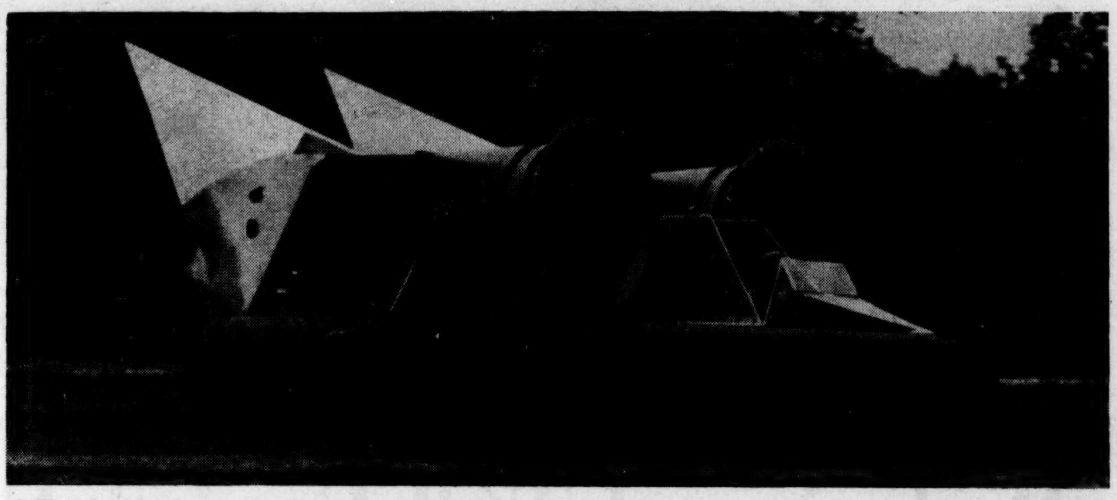
Military's desire for more mobility plus the commercial market for cheap but speedy over-water transportation, especially in underdeveloped areas, is spurring the development of vehicles which skim over land and water on a cushion of air.

Such experimental air cushion vehicles as the ones pictured have convinced many government and industry aerodynamicists that the concept is sound and worthy of further development. The Navy and Maritime Administration both demonstrated the growing U. S. interest by awarding sizable contracts in recent weeks for the design and construction of ground effect machines.

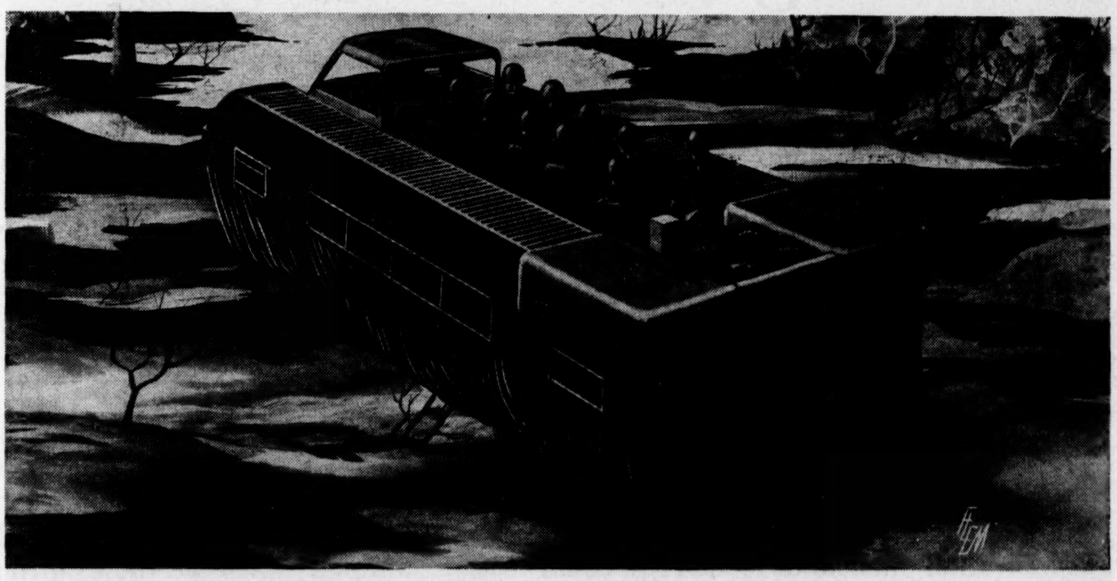
Navy signed a $2,040,000 contract with Bell Aerosystems Co. to build a 20-ton air cushion vehicle (AW Dec. 4, p. 34). A primary concern is whether such air cushion vehicles, also known as ground effect machines (GEMs), would be effective in antisubmarine warfare.

U. S. Marine Corps annular jet ground effect machine (GEM 3 at top right), built by National Research Associates, has undergone extensive testing at Navy's David Taylor Model Basin. Two 70-hp. Solar YT62S-2 gas turbine engines drive the 12 x 23 ft., 2,020-lb. vehicle up to 20 mph. Vehicle has airplane-type control stick. Army believes air cushion vehicles promise added mobility, especially for taking troops and cargo over water and rough terrain. Aeronutronic Division of Ford Motor Co. is building such an experimental vehicle with its own money (middle right). Flexible 2-ft. skirt adds to clearance provided by air cushion itself. Two 260-hp. Lycoming O-540 engines power vehicle.

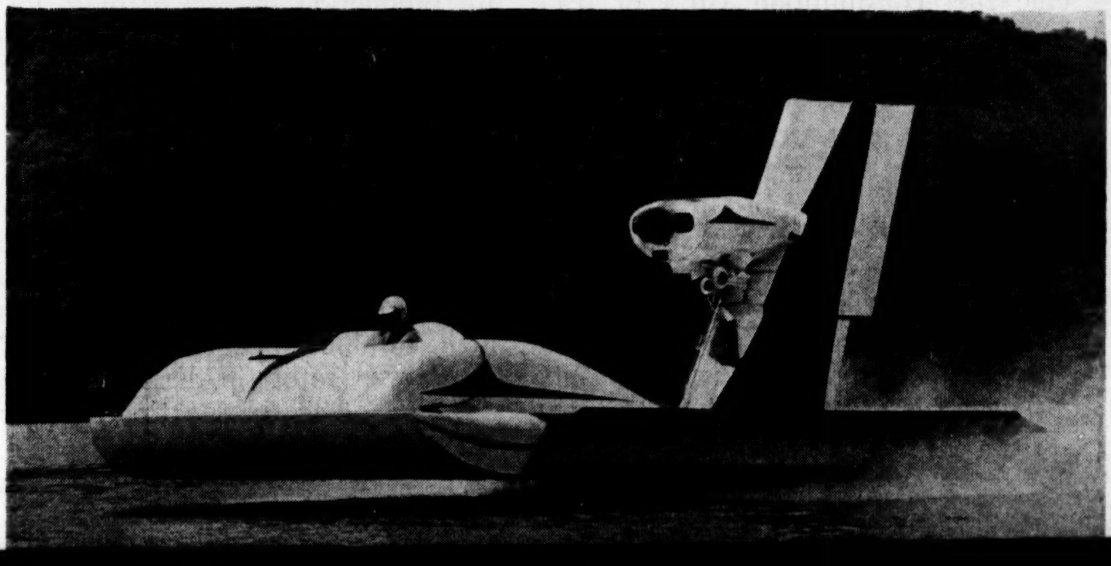
Reynolds' vehicle (bottom right) carries four persons, can attain 75 mph. The company's Everglades Speedster gets lift from 150-hp. Lycoming piston engine (not visible in photo), and forward propulsion from similar engine on tail. Ducts along sides of the vehicle are intakes. Vehicle is 14 ft. x 31 ft., weighs 4,000 lb.

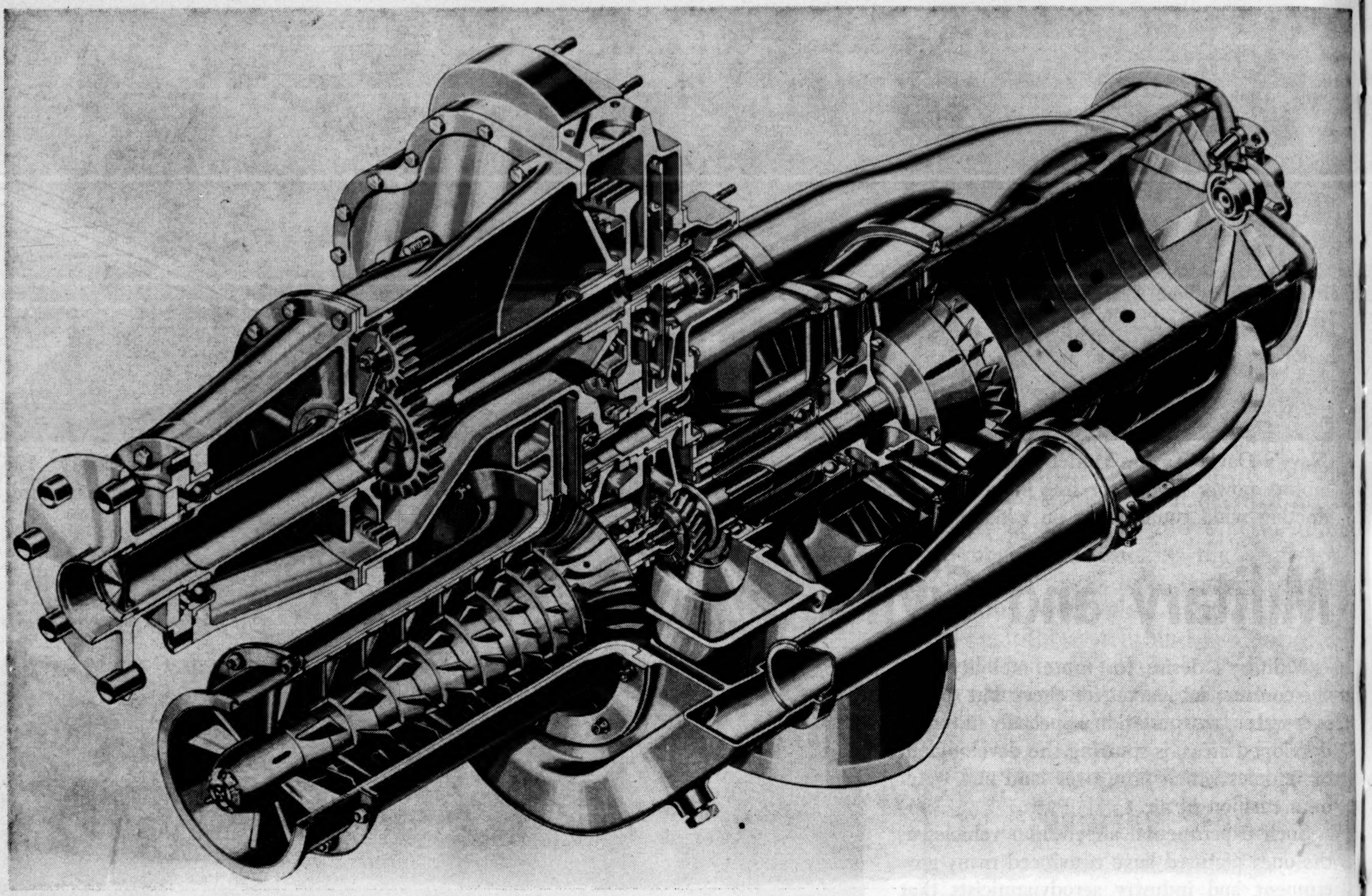


GEM 3 vehicle was built by National Research Associates, has been extensively tested.



Ford Motor Co.'s Aeronutronic Division concept above would have flexible skirt. Below, Reynolds Metals Co. Everglades Speedster gets lift from a downward-pointing engine.





ALLISON T63-A-1 turboprop free power turbine engine shown in cutaway drawing here had seven axial compressor stages. A-3 and A-5 versions have six stages. Air enters at left, passes through the axial stage and into the centrifugal stage and diffuser. It then goes aft through two ducts, to the combustor. Hot gases then energize the gasifier turbine which drives the compressor and then turn the power turbine which is mechanically connected to reduction gear mounted on top of the engine.

Redesigned T63 Engine Ends 50-hr. Test

By Larry Booda

Indianapolis—After three years of development, including one complete internal redesign, the Allison T63-A-3 lightweight turboshaft gas generator-free turbine engine has completed its 50 hr. preliminary flight rating test (PFRT). Results have been sent for acceptance to the Air Force Aeronautical Systems Division, acting for the Army.

Early this month, Allison, a division of General Motors Corp., demonstrated that the engine, which is scheduled to power the Army's four-place light observation helicopter (LOH), could produce a guaranteed 250 horsepower at a dry weight of 137.4 lb. and a specific fuel consumption (sfc.) of 0.71 lb./shp.-hr.

This weight is much more than the original goal set by the Army. Requests for proposals sent to industry in 1958 said the aim was to produce 250 hp. in a package weighing 110 lb. as a turboprop and 95 lb. as a turboshaft. It took one year of effort on the part of Allison and nearly $6.4 million—split evenly between the company and the Army—to discover that this aim was unrealistic.

The Army was so unsure of the success of the project two months ago that it decided to send proposal requests for an alternate engine as a backup to the T63. This called for an engine weighing 137 lb. With this weight limitation, existing engines of greater horsepower would have difficulty qualifying by being derated. Companies entering the competition would probably have had to start from scratch.

Early Delivery Date

The Army's concern was due to the fact that delivery of five engines each is scheduled to Bell, Hiller and Hughes next summer. Each of these airframe manufacturers is producing five LOH prototypes. One model will be chosen for production by one or more manufacturers. Long-range program is about 3,000 helicopters, which will replace current fixed-wing lightcraft and helicopters.

The magnitude of the problem in developing this engine has been due to its small size, combined with a requirement for a compressor pressure ratio ranging between 6 to 1 and 8 to 1, and high turbine inlet temperature. The compressor rotor tip diameter is 4.314 in. First stage turbine tip diameter is 6.17 in. and the second stage is 6.434 in. The combustor diameter is 5.5 in. Takeoff gasifier turbine rpm. is 48,750. Turbine inlet temperature is 1,650F.

In the history of turbine engines one of the greatest problems has been keeping compressor-casing and turbine-casing clearances at a minimum to hold leakages at the lowest possible level. This also applies to suspension points and overlap points between components.

But what would be a small percentage clearance in a large turbine engine would be unacceptably large in a small engine, where the percentage of leakage would reduce efficiency.

Overcoming these leakages was one of the greatest challenges faced by the project engineers. In the compressor section this was solved in an ingenious manner which will be described later. But it was the original internal configuration which caused the greatest headaches.

Army studies completed in 1957 showed the need for a 250-hp. engine as small, light and inexpensive as possible. Four engine manufacturers submitted their solutions. As a result of this study competition, Allison was awarded a contract in June, 1958, to design and develop the T63 engine. The contract schedule called for the 50 hr. PFRT to be completed late in 1960 and the 150 hr. final qualification test late in 1961.

Because the engine was intended for a wide range of uses in fixed-wing aircraft, helicopters, tiltwing VTOL aircraft and auxiliary power units, the requirements included the ability to start, stop and operate in a wide variety of attitudes from 20 deg. to 15 deg. past vertical with a simultaneous roll of 20 deg. to either side. It was also required that the engine maintain 250 hp. on a 100F day and 206 hp. at 6,000-ft. altitude on a 95F day. This latter figure is of special interest to helicopter manufacturers.

The original engine, dubbed Type I by the company, was first run in the spring of 1959. Its runs encountered difficulties due to high inlet temperatures which prevented full speed tests, and mechanical distortions which caused the turbine rotor to seize.

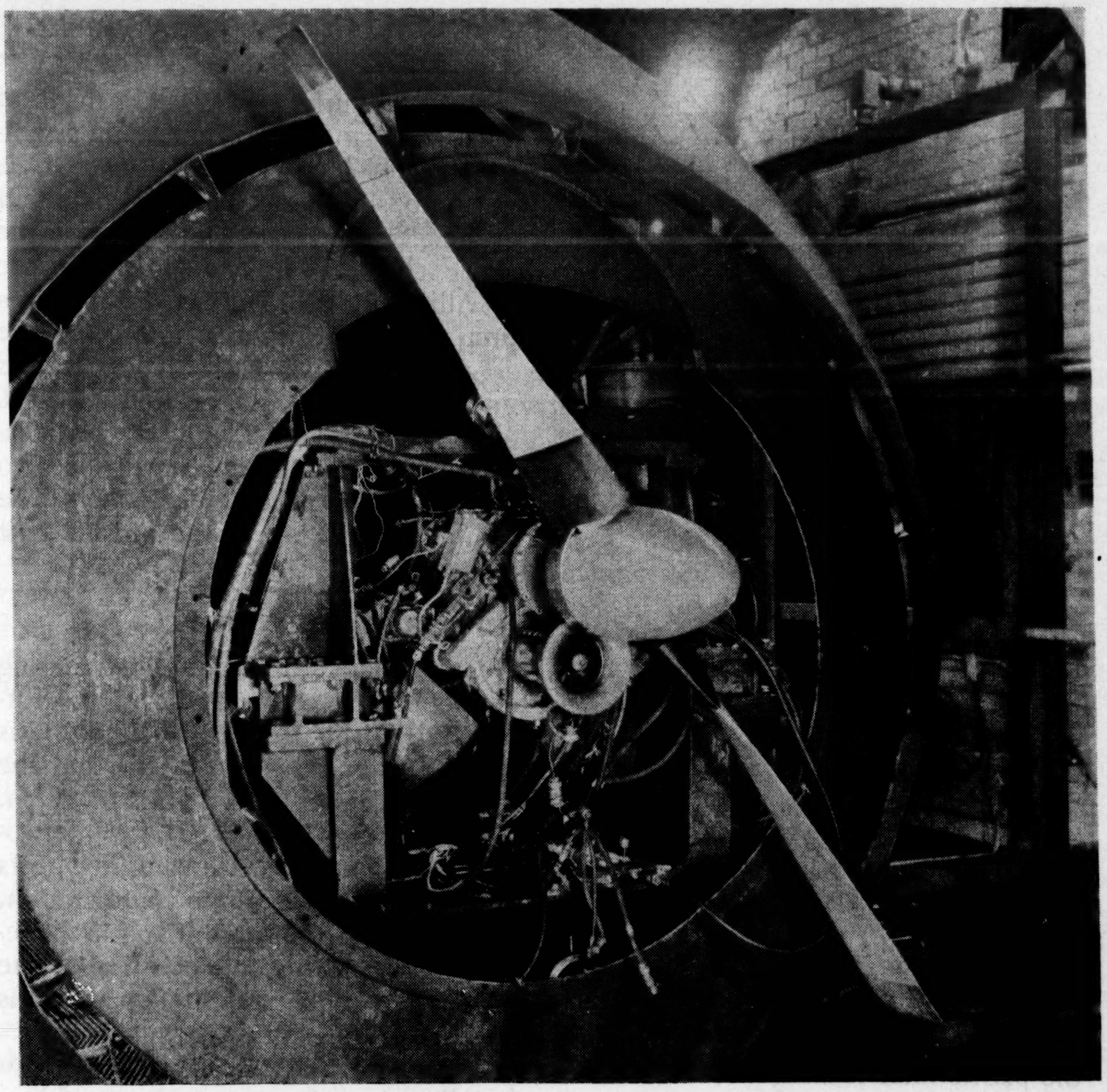
The cantilevered suspension design of the gasifier and power turbines was subject to these distortions with changes in temperature. In this arrangement the gasifier, or gas producer turbine, shaft was mounted in a bearing which in turn was mounted on the exhaust duct between the turbine and the combustor chamber. The opposite part of the shaft traveled inside the power turbine shaft and rode on roller bearings running between both shafts beyond the hot section. This gasifier shaft ran the compressor at the opposite end of the engine.

Thus the two-stage power turbine large hollow shaft rode hanging from the roller bearings. This design proved to be a weight saver but would not retain its alignment at operating temperatures.

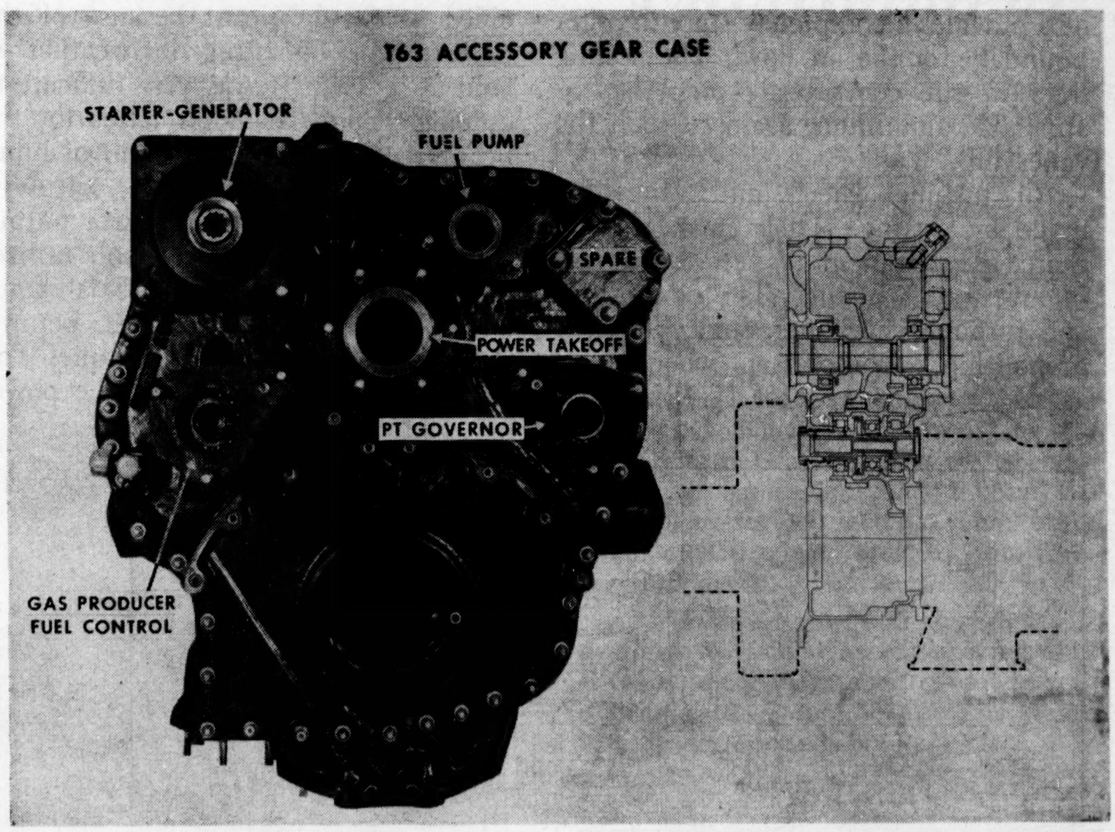
Fixes were made, but finally it became obvious there was little possibility of arriving at a mechanically compatible engine. No amount of improvements eliminated the 3½% deficiency in compressor flow and the 7% low efficiency, and the power turbine bearing support distortion.

In mid-1959 a critical decision was made to scrap the initial aerodynamic design and turbine mechanical arrangement. All running of the Type I engine was stopped and all effort was concentrated on the new arrangement.

The Type II turbine section retained the basic T63 arrangement of major components. From front to back are: the compressor inlet with a bullet nose; the six-stage axial compressor; the centrifugal compressor and diffuser; the accessory drive gear box which serves as the "backbone" for the engine and on which all the major components are mounted; the two-stage power turbine; and the two-stage gasifier turbine and the combustor.



Y63-A-1 turboprop version is shown here on propeller test stand. Principal effort is now being directed on A-3 and A-5 models which are destined to power the Army's light observation helicopter.



FIVE accessory drives, including one spare, are included in the T63 accessory gear case. A seven-element oil pump, incorporating one pressure and six scavenging elements, is also located inside the case.

Two ducts, one on each side, carry the compressed air aft to the combustor chamber. Power is taken from the forward side of the accessory gear box in the turboshaft version. In the turboprop version the reduction gear housing is mounted at the same point.

The new design called for new blade and vane blading and a new flow annulus. The gasifier turbine was changed from a single stage to two stages. The gasifier turbine is straddle-mounted between a roller bearing forward and the thrust bearing aft. The power turbine is straddle mounted between a thrust and roller bearing forward and a roller bearing aft. Separate rings made of a special material were installed outside each turbine rotor to assure minimum clearance at operating speeds. Dual outlet exhaust ducts were included.

Revised requirements stated that the attitude ranges for starting, stopping and operating were to be from 75 deg. above horizontal to 25 deg. below horizontal. This required oil system and oil seal changes. In order to assure lubrication at all mandatory attitudes, there are six scavenger points to pick up oil for transmission to the pump.

The compressor section was altered little in the redesign phase, the biggest change being reducing the number of axial stages from seven to six.

The outer case is made of light gage stainless steel stock. The stripstock stator vanes are attached to hat sections by copper brazing. These assemblies are in turn spot welded to the casing. An abradable plastic is centrifugally cast into the case, covering the hat sections.

Leakage Reduced

When assembled, the rotor vanes fit the plastic liner so snugly that the rotor binds. It is then turned by hand until the vanes cut their own grooves in the plastic. Thus a tight seal is assured and leakage cut to a minimum. The plastic also provides a completely smooth outer boundary for the air flow. The sealing liner in the centrifugal compressor is abradable aluminum, against which the vanes rub.

All turbine wheels and vanes are made by casting. Their small size required development of new techniques in investment casting. The compressor and turbine wheels are single piece, or monolithic. Compressor wheels and stator vanes are made of 17-4PH stainless steel. Turbine wheels are made of Inco 713C and the turbine vane assemblies of HS-31.

Combustor design and development created no great difficulties, since the single chamber approximated the size of Allison's 501 (Military T56) turboprop chambers. Fuel is injected in the aft end of the combustor. Next to this injection point is the igniter. Because of Federal Aviation Agency certification requirements, there will be two igniters in the production model. The combustor attaches to the turbine unit with 24 bolts.

Hotspots Encountered

Only difficulties encountered during development were hotspots in the turbine inlet gas path. Liner diameter was reduced from 6.0 in. to 5.5 in. and the length increased from 10 in. to 12 in. These changes resulted from two-dimensional transparent water flow tests of the combustor-turbine configuration. It was shown that secondary air penetration and mixing was occurring. The turbine inlet temperature pattern is now stable and consistent.

As stated, the gear case is the anchor for all unit accessories and assemblies. Principal problem presented in design centered around the requirement that MIL-L-7808 low viscosity oil was specified as the lubricant because of the necessity of operating in weather as cold as −65F. It was very difficult to establish length-diameter ratios for the bearings and size and location of lubrication points.

In the vicinity of the power output there is a torque sensor which utilizes oil pressure to resist the axial force from helical gears. A gage permits readings in pound-feet of torque. The power gear train also drives the power turbine tachometer and the power turbine fuel governor. The gasifier gear train drives the fuel control, the fuel pump, the oil pump, the starter-generator, the tachometer and the spare accessory pad. A seven element oil pump is mounted inside the gear case. It has one pressure element and six scavenging elements.

The gear case assembly without accessories weighs 35.9 lb. The main and cover castings are made of AMS 4434 magnesium and the gears are made of AMS 6260 steel. Anti-friction bearingings are used throughout.

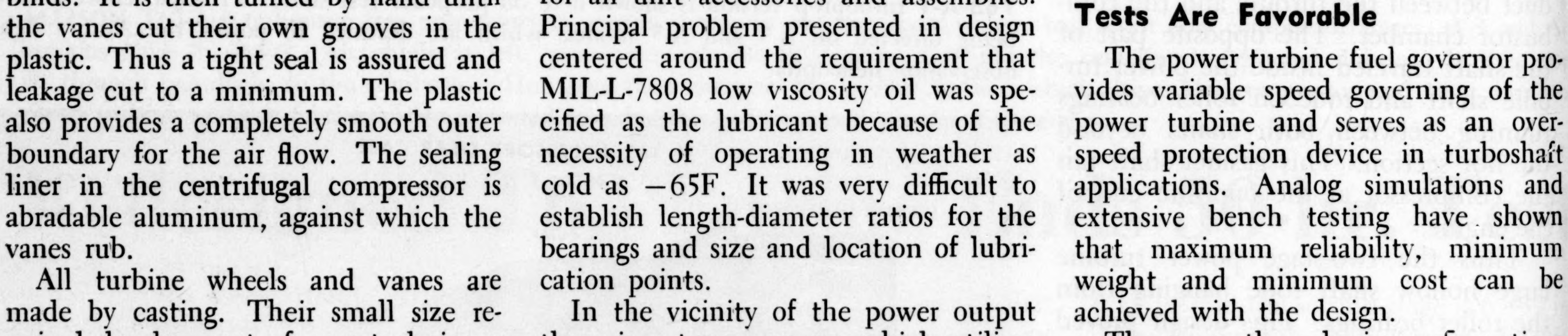
From the beginning of design it was determined to keep the fuel control system as simple as possible. Consequently, there are no electronic devices, potentiometers or other sophisticated controls. This is made possible by the 20,000-ft. altitude limitation of the specifications.

A gasifier fuel control and a power turbine fuel governor constitute the control system. They are both located between the fuel pump and the fuel nozzle. The gasifier control provides fuel for rapid accelerations and decelerations of the gasifier speed.

Tests Are Favorable

The power turbine fuel governor provides variable speed governing of the power turbine and serves as an overspeed protection device in turboshaft applications. Analog simulations and extensive bench testing have shown that maximum reliability, minimum weight and minimum cost can be achieved with the design.

There are three basic configurations of the T63. The YT63-A-1 is a turboprop with a downward pointing exhaust. The YT63-A-3 is a turboshaft version with exhaust down. Both of



PRESENT T63 internal configuration is at left. There are three bearing points for both the gasifier and power turbine shafts—on the right, the middle and the left. Discarded configuration is on right, with bearings on left and right and one between concentric shafts.

T63-A-5 Model Specifications

Gas producer section: Combination of a six-stage axial and one-stage centrifugal flow compressor directly coupled to a two-stage gas producer turbine.

Power turbine section: Composed of a two-stage free turbine section which is gas-coupled to the gas producer section.

Integral gear reduction gear box to a spline output drive at front of gearbox.

Single combustion chamber, upward exhaust.

Governing military specifications: MIL-E-5009B, turbojets qualification tests; MIL-E-5010B, turbojets, acceptance tests; MIL-W-5846B, wire, electrical, chromel or alumel, thermocouple; MIL-E8593, general specifications for turboprops; MIL-I-26600, interference control requirements.

Ratings are based on use of fuel with a lower heating value of 18,400 Btu./lb., MIL-J-5161. Alternate fuel, grade 115/145 fuel.

these were designed for an sfc. of 0.78. It has been the A-3 version which has gone through the 50 hr. PFRT.

The final configuration for installation in the LOH is the A-5 engine whose exhaust will point upward. It will have a refined compressor and changed exhaust duct. This is the engine which will be aimed at passing the 150 hr. production test. Its sfc. will be 0.71 or less.

The A-3 engine actually passed an official 50-hr. PFRT in March of this year and was basically satisfactory. On a subsequent development endurance test, Allison and USAF decided not to permit shipment of the engines until a wheel problem was solved.

Test Approval Deferred

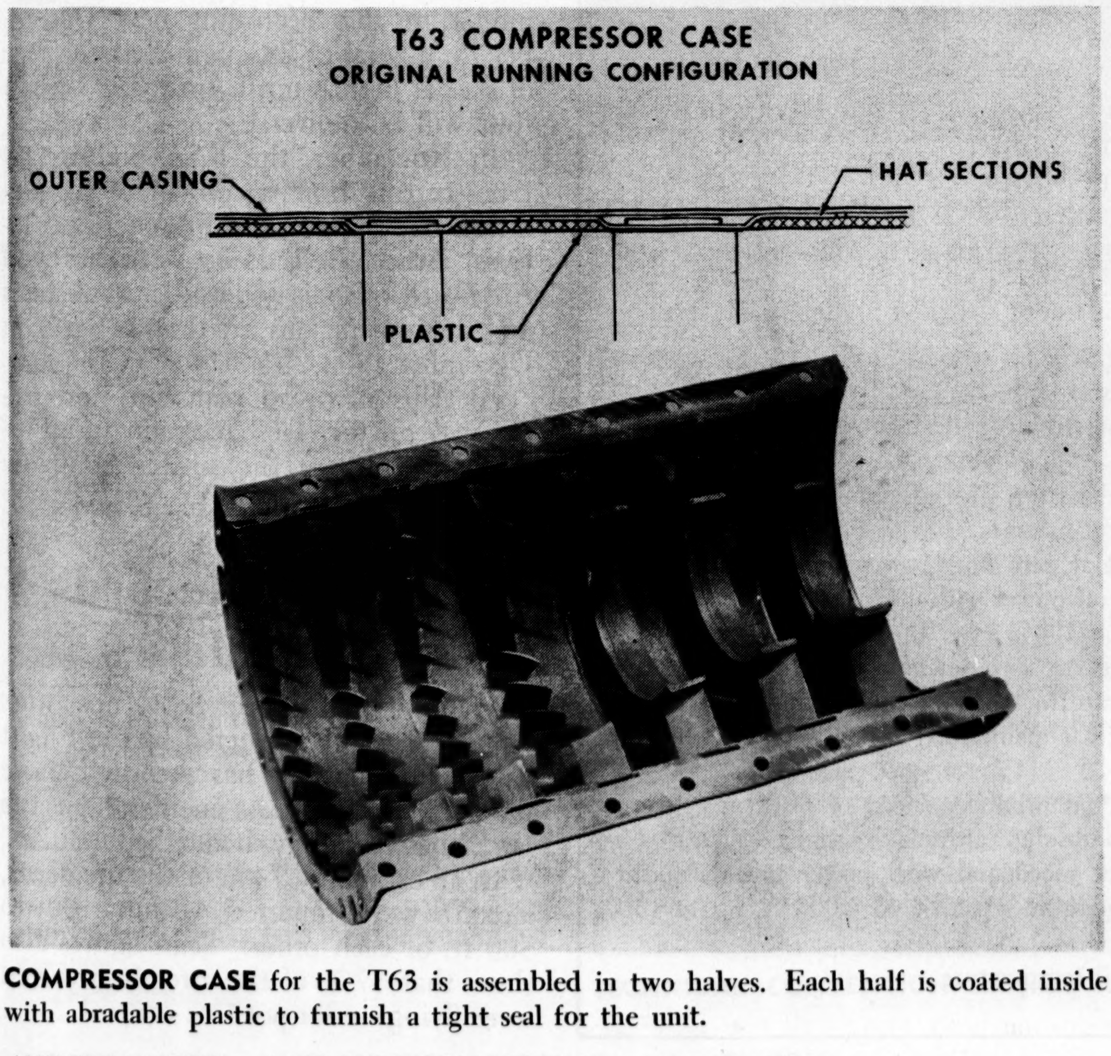
In July, another test was also basically satisfactory. However, another development engine produced a failure of a compressor impeller inducer vane and the company did not request approval of this test as the official A-3 50-hr. PFRT.

Another test period was terminated in September after 29 hr. 12 min. by the failure of the first stage turbine wheel disk. This test had been run at a higher turbine wheel temperature and higher speed than previous tests.

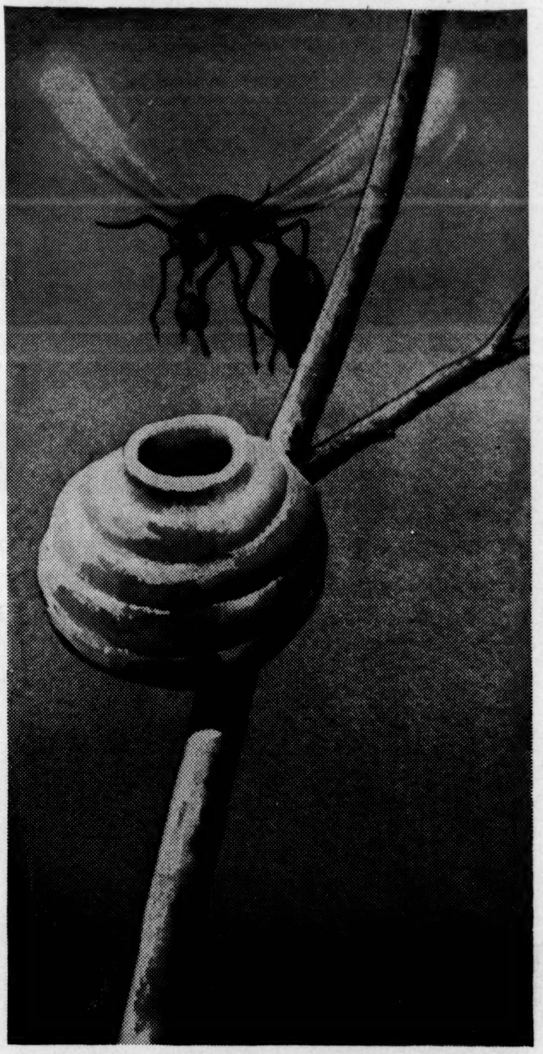
October and November marked the turning point for the program. A turbine wheel change incorporated strengthening, cooling and lower operating speed. A company test involving 250 starts was successfully completed in October. Parts were inspected by the USAF representative.

Another company test in October consisted of 60 hr. of running in a PFRT. Parts from the engine, although not perfect, were also inspected by the USAF representative after the test.

The engine has demonstrated the following capabilities:



COMPRESSOR CASE for the T63 is assembled in two halves. Each half is coated inside with abradable plastic to furnish a tight seal for the unit.


Engineered Environment

The thimble-sized nest of the potter wasp is a feat of engineered environment as well as artistry. The mother wasp carefully gathers hundreds of particles of wet clay and positions them inside the nest so that air can circulate around them. This maintains proper humidity for larvae during the hot, dry months.

How is humidity control being handled in *your* project? Proper and reliable functioning of electronic components as well as the efficiency of personnel depend on precision humidity control. Specialized AAF equipment that "tailors" the atmosphere for you includes many other engineered products built to rigid military standards.

AAF's half century of experience is available to you. Our engineering staff is ready to collaborate with yours in conquering environmental control problems. "Better air is our business."

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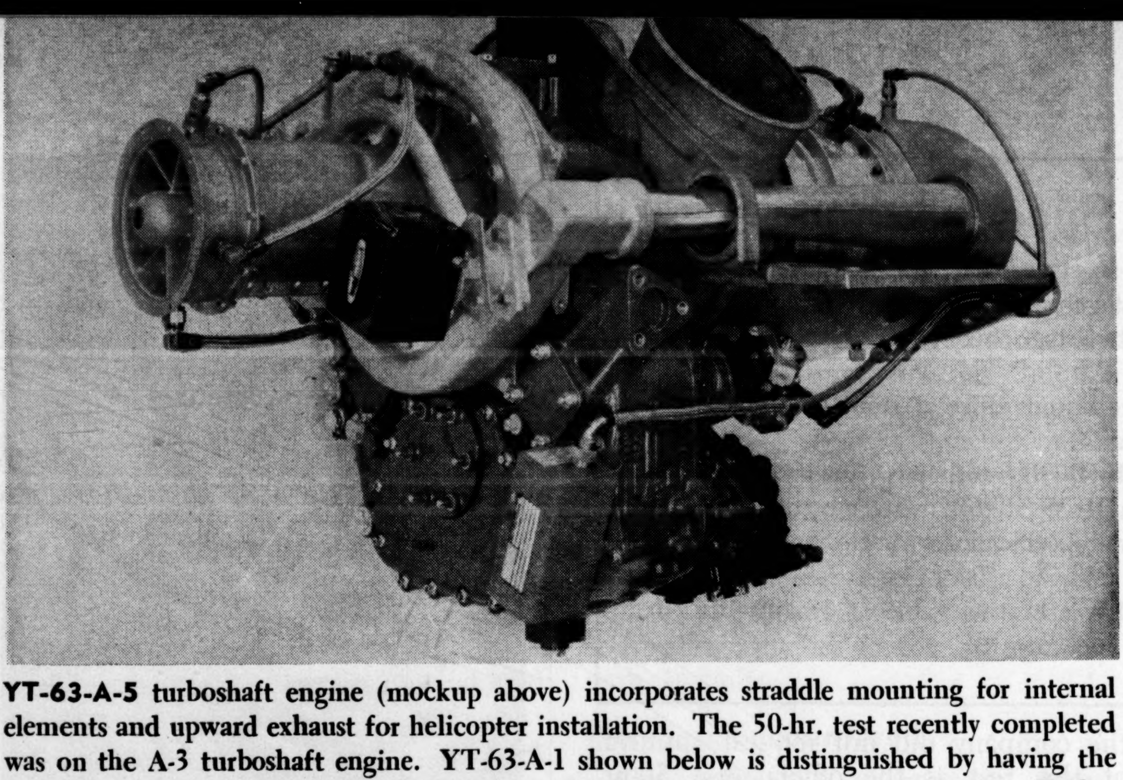
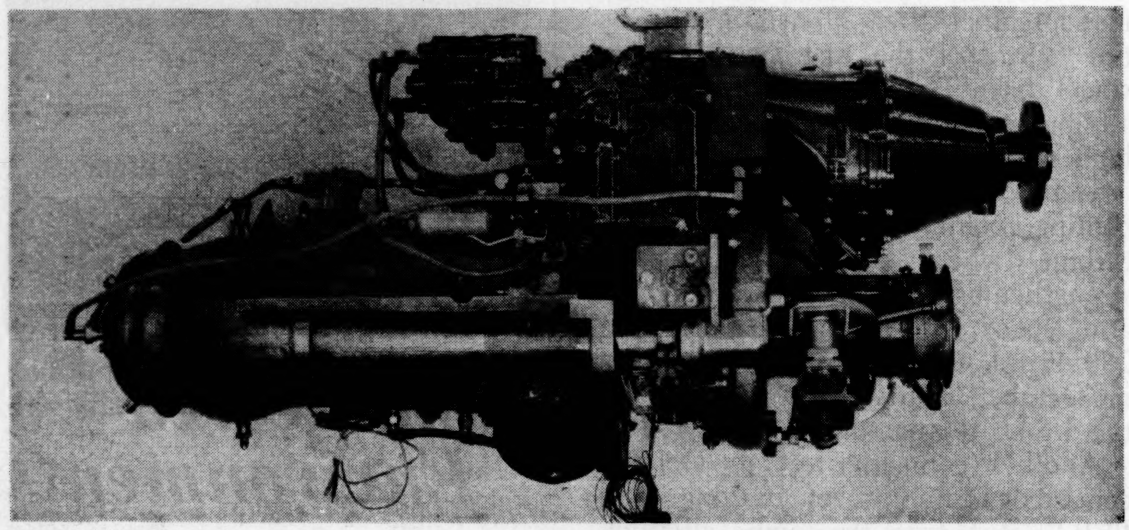


YT-63-A-5 turboshaft engine (mockup above) incorporates straddle mounting for internal elements and upward exhaust for helicopter installation. The 50-hr. test recently completed was on the A-3 turboshaft engine. YT-63-A-1 shown below is distinguished by having the propeller reduction gear casing mounted on the front of the accessory gear case. Turboshaft output of 6,022 rpm. is reduced to 2,057 rpm.



T63-A-5 Performance Ratings

	Shaft hp.	Net jet thrust (min.) lb.	Gas producer rpm.	Output shaft rpm.	Sfc. lb./ shp.-hr.	Gas producer turbine inlet temp.
Takeoff Military . . .	**250**	**36**	**48,750**	**6019**	**.71**	**1,650 F**
Normal	**212**	**31**	**47,050**	**6019**	**.74**	**1,567**
90% Normal	**191**	**29**	**46,100**	**6019**	**.77**	**1,518**
75% Normal	**159**	**25**	**44,550**	**6019**	**.82**	**1,449**
Idle	**20**	**6**	**30,770**	**4590**	**60 lb./hr.**	**1,420 ± 100**

Maximum fuel flow—225 lb./hr., ±10 lb./hr.

Oil consumption—0.15 gal./hr.

Air starts up to 20,000 ft. and 0 to 250 kt. true air speed.

Absolute altitude-20,000 ft. at 1.0 ram pressure ratio.

Capable of starting, stopping and operating from 75 deg. above horizontal to 25 deg. below horizontal.

Capable of continuous operation at attitudes from 75 deg. above horizontal to 45 deg. below horizontal.

With gas producer and power turbine set at zero horsepower and power turbine speed of not less than 95% accelerate to takeoff power within four-second at sea level provided power turbine speed is maintained at 100% after the four-second period.

With gas producer and power turbine set at zero horsepower and with power turbine speed of not less than 95%, accelerate to takeoff power within five second at 6,000 ft. provided the power turbine speed is maintained at 100% at the end of the five-second period.

With power turbine speed of 100% and gas producer speed of 60%, accelerate to military power in 10 sec. from 6,000 ft. to absolute altitude.

From takeoff power to 60% gas producer speed and with power turbine speed maintained at 100% decelerate in five second from sea level to 6,000 ft. up to 130 kt. TAS.

Oil pressure 125 psi. ±5 psi., and 185F oil temperature.

- **An sfc. of 0.71** for takeoff horsepower of 250 on a standard static day at sea level.
- **A takeoff sfc. of 0.73** for a sea level 95F day.
- **A normal operation** at 212 hp. and a consumption of 0.74 at sea level on a static standard day.
- **At 6,000 ft. altitude,** 95F inlet temperature and 206 hp., and sfc. of 0.73 at military rating.
- **At 9,000 ft.,** standard air temperature and 250 hp. an sfc. of 0.654.
- **Ability to start,** stop and operate over the attitude range previously mentioned.
- **Accelerated from 0 to 250 hp.** in four seconds and from 250 hp. to idle in five seconds. This has been done on each 50-hr. engine.

Specification weight for the A-3 engine is 135 lb. The current weight on the 50-hr. engine is 137.4 lb. Steps are being taken to have the specification weight changed to 138 lb.

The engines tested so far have demonstrated specific fuel consumptions at turbine inlet temperatures of 1,650F of less than 0.67. Project Engineer John M. Wetzler believes as development proceeds this figure can eventually reach as low as 0.63 lb./hr.

The official 50 hr. PFRT for the A-5 production engine is scheduled for next March. Engines will be delivered to Bell, Hiller and Hughes as follows: Three in June, and six each in July and August. The 150 hr. test is scheduled for September. Concurrently, demonstrations of environmental traits and emergency fuel operations will be conducted.

Deliveries of the production A-5 model are due beginning next December for a total of 28 engines at the rate of six per month until April, 1963 when four will be delivered.

In November, the FAA preliminary type certification board met. In addition to company and FAA representatives, Army, Bell, Hiller, Hughes and Air Force officials attended. FAA tests and demonstrations are due to begin in December 1962.

At Allison, broad plans are now under way on the T-63 program in an attempt to recover the sizable company investment in the project.

Foundation Records 1,300 Near Misses

Washington—Project Scan, near miss report program conducted by the Flight Safety Foundation, has recorded more than 1,300 near miss incidents in the U. S. between July 1 and Sept. 30.

In an estimated 74% of the incidents, aircraft were reported within 100 to 500 ft. of each other. Scan figures also show that 57% of the aircraft involved were flying under positive control.

MANAGEMENT

Ideas Advanced to Improve Conventions

(In a talk entitled "Technical Conventions: Ego Gratifiers or Information Amplifiers?" given at the Institute of Radio Engineers Conference on Technical-Scientific Communications in Philadelphia, Aviation Week Avionics Editor Philip J. Klass, a veteran of more than 200 technical conventions, suggested changes which could make conferences more useful to the scientific community.)

The technical convention, which could be one of the most effective media for exchanging important new scientific information, has degenerated into something which too often serves its sponsors better than it serves the scientific community.

The primary objective of a technical convention should be to transfer the maximum amount of useful information from the few who have made notable advances in technology to a large group of fellow scientists with the minimum expenditure of time and money. In other words, technical conventions should serve as "information amplifiers."

Many technical conventions fall far short of this objective, serving instead primarily as "ego gratifiers" for their sponsors and speakers who have nothing significant to report.

This situation stems from two basic shortcomings in the procedure now used to schedule and conduct technical conventions:

- **Lack of control and coordination** between technical societies and even within a single society, which results in mushrooming numbers of overlapping and duplicative conferences.
- **Inefficient format** used in the conduct of conferences which encourages mediocrity in the technical presentations and wastes the time of those attending.

Mushrooming Numbers

During the past five years, the number of technical conventions sponsored by the Institute of Radio Engineers (IRE) has increased nearly 80% (AW Nov. 21, 1960, p. 73).

In the fields of aerospace technology and avionics, the number of conventions is increasing by nearly 20% each year.

In a dynamic technology, a modest increase in the number of conferences is to be expected. But the bulk of the increase stems from competition between technical societies or between rival groups within a single society to stake out claim to new technical areas. The result is near chaos which makes it impossible for the average engineer to attend more than a fraction of the conventions with papers on subjects of interest.

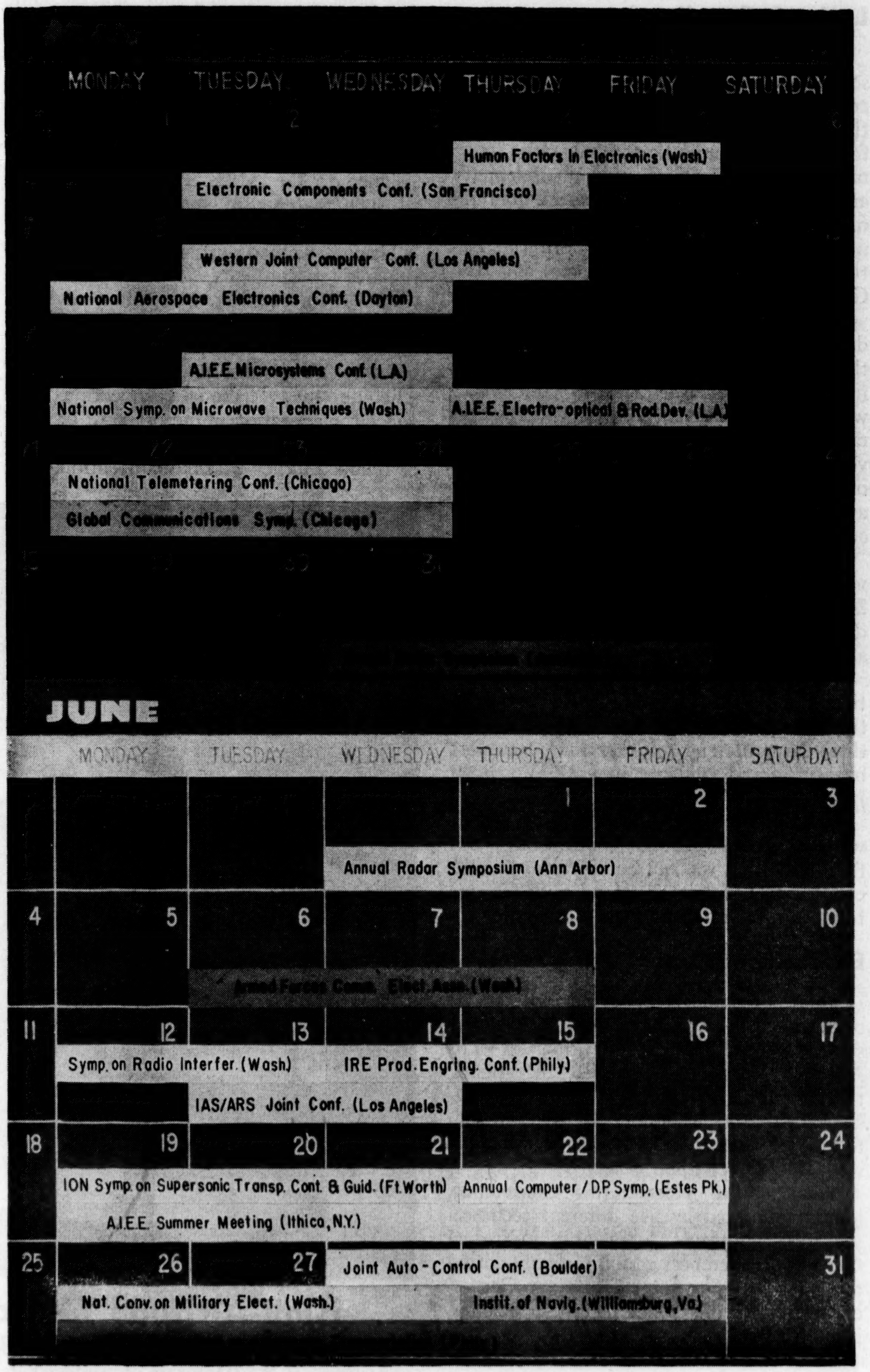
Consider, for example, the field of communication satellites. During the months of May and June, 1961, there were five national conventions at which papers were delivered on the subject of communication satellites.

These included:

- **May 8-10:** National Aerospace Electronics Conference, Dayton, sponsored by the IRE Professional Group on Aerospace and Navigational Electronics.
- **May 22-24:** Global Communications Symposium, Chicago, sponsored by the IRE Professional Group on Communication Systems and the American Institute of Electrical Engineers (AIEE).
- **May 26-27:** Conference on Peaceful Uses of Space, Tulsa, sponsored by the Tulsa Chamber of Commerce and the National Aeronautics and Space Administration.
- **June 13-15:** Joint Institute of Aerospace Sciences and American Rocket Society Conference, Los Angeles.
- **June 26-28:** Military Electronics Convention, Washington, sponsored by IRE Professional Group on Military Electronics.

Convention Attendance

To attend these five conventions, an engineer working in the field of communication satellites would have had to spend



TECHNICAL CONVENTION calendars for May and June show overlapping sessions.

a total of nearly three weeks away from his desk during this two-month period. Yet if all of these papers on communication satellites had been given at a single convention, they could have been delivered in less than three days.

To attend these five conventions, an engineer living on the East Coast would have had to travel a total of about 12,000 mi. in the two-month period, while an engineer living on the West Coast would have covered some 15,000 mi.

An engineer working in radar systems could justify attendance at six, or perhaps eight, technical conventions during the same two-month period. But he would have had to spend nearly half his working days away from his desk if travel time is figured into the total.

Lack of Coordination

Even within a single national technical society there often is a deplorable lack of coordination and control of national conventions. For example, since telemetry is a form of communications, and pulse code modulation techniques used in telemetry are finding increased use in general communications, an engineer working in this field might profit from attending both the National Telemetering Conference and the Global Communications Conference.

Although both conferences were held during the same three-day period in Chicago this year, this was the result of chance and not prearrangement. The two conferences were held in different hotels, widely separated geographically, so that it was inconvenient if not impossible during a morning or afternoon session for an engineer to hear a paper at one conference and then to hear another paper at the other.

At the annual Institute of Navigation convention in Williamsburg, Va., held June 28-30, one of the five technical sessions was devoted to supersonic transport navigation and guidance.

Yet only two months before this convention, the Western region of the same institute announced plans to hold its own three-day conference on supersonic transport navigation and guidance in Fort Worth on June 19-21.

Some of the papers given at Fort Worth were later delivered at Williamsburg but the duplication was not complete so that an engineer would have to attend both sessions to be sure of hearing all papers of interest.

Encouraging Signs

There are some encouraging signs on an otherwise dark horizon. One is the jointly sponsored IAS/ARS convention in Los Angeles. These two societies, recognizing the overlapping interests of their memberships, acted to accommodate the best interests of their members rather than the self interests of either society.

The National Telemetering Conference, jointly sponsored by five different technical societies, replaces several individual telemetry conferences which formerly dotted the calendar. The Joint Computer Conferences, sponsored by three technical societies, is another example.

These examples demonstrate what could be achieved if all of the major technical societies were to recognize the problem and act in the best interests of the over-all scientific community.

Specifically, the technical societies need to form an Inter-Society Convention Coordinating Committee. The first action for such a committee would be to delineate those technical areas which are of exclusive interest to a single society and those which overlap the interests of two or more societies.

For each of the areas of overlapping interest, an inter-society subcommittee would be formed, with representatives of each interested society. This subcommittee, whose members would be selected for their expertise in the particular field, would then delineate sub-areas of primary interest for each of the interested technical societies.

For example, in the field of exotic energy conversion which overlaps the interest of several societies, the subcommittee might decide to assign the sub-area of thermionic conversion to the IRE because it draws heavily on vacuum tube principles. The sub-area of thermo-electric conversion might be assigned to the American Electrochemical Society, while solar-powered dynamic systems (turbo-electric) might be assigned to the AIEE. The application of all such systems to space vehicles might be assigned to the American Rocket Society.

Having worked out mutually agreeable sub-area assignments, the subcommittee would then consider how many national conventions, and of what duration, are needed to report new advances in the technology. The subcommittee would then schedule these national conventions and select their location. One or more of these might be scheduled to immediately precede or follow another national convention, such as an IAS/ARS conference on space technology, for the convenience of attendees.

Except for these national conventions, there would be no other papers authorized for delivery on this subject at any other convention. This means that an engineer working in the field of exotic energy conversion, for example, would be able to hear all significant advances in his field by attending three, four, or perhaps five national conventions each year, instead of the dozen or more he is obliged to attend at present.

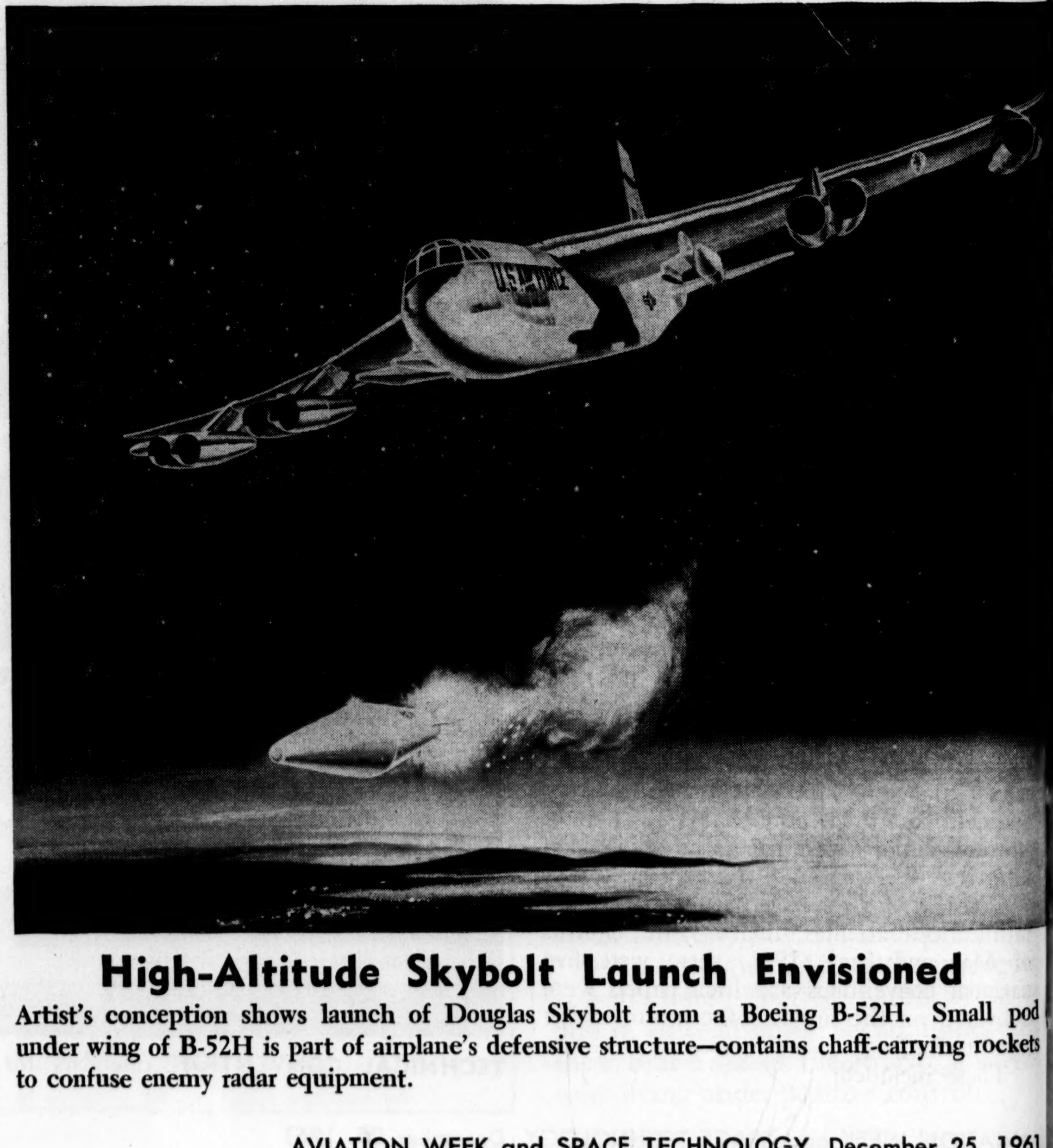
For the very large technical society, such as the IRE many of whose 28 professional groups have overlapping interests, similar steps should be taken to clearly delineate sub-areas of interest to each and to apply intelligent coordination and control of their individual conferences.

That such inter-society coordination and control is feasible is demonstrated by the recently formed American Federation of Information Processing Societies (AFIPS). This federation, representing the IRE Professional Group on Electronic Computers, AIEE and Assn. for Computing Machinery (ACM), has assumed control and sponsorship of the Joint Computer Conferences.

Without intelligent control and coordination, competition between societies and groups within societies, spurred by geographic rivalry and pride, will result in further mushrooming of the number of technical conventions which compete for audiences and technical papers.

A second aspect of technical conventions which is in serious need of change is the format used to transfer information from the authors to the audience.

Every year industry invests millions of



High-Altitude Skybolt Launch Envisioned

Artist's conception shows launch of Douglas Skybolt from a Boeing B-52H. Small pod under wing of B-52H is part of airplane's defensive structure—contains chaff-carrying rockets to confuse enemy radar equipment.

dollars in the time and travel expenses of the engineers and scientists it sends to technical conventions. Unless such trips are considered primarily as a means for providing an expenses-paid vacation on company time, most conventions provide very little return for this investment.

Present Shortcomings

Here are some of the shortcomings of the present convention format:

- **Paper selection:** Choice of speakers and their papers often is made by local groups sponsoring the convention whose members may lack expertise in the broad spectrum of subjects covered. Selection usually is made on the basis of a brief abstract which often reveals little about the usefulness or contents of the proposed paper. Only after the paper has been written, usually several months after the authors have been selected, is it possible to actually evaluate its real worth.
- **Paper presentation:** It is far easier to understand and grasp a technical paper by reading it in printed form than by listening to an oral presentation. This is especially true when the author merely stands up and reads the printed paper. Furthermore, it is far faster for a convention attendee to read the paper in the proceedings than to listen to its oral delivery. The printed papers can be scanned quickly to find subject matter of interest whereas in the lecture hall, the listener must move at the speakers pace, investing 30 min. of his time in the hope that the speaker will have something of value to report.
- **Paper scheduling:** Because too many sponsors of technical conventions believe the value of a convention to its audience is directly related to the sheer quantity of papers presented, many conventions schedule three, four or more simultaneous paper sessions. Often, papers of interest to members of the audience are scheduled for simultaneous presentation in different sessions, making it impossible to hear all papers of interest.
- **Informal exchanges:** The informal "bull sessions" that take place in the convention or hotel corridors are one of the most effective means of communication between engineers and scientists with similar interests. But the usual convention schedule is so crowded with papers that there is too little time available for such informal exchanges. When they do occur, it is by chance and not the result of program planning.

Proposed Changes

Many of these convention shortcomings can be eliminated or minimized by adopting a new procedure for the conduct of such conferences. Here are several proposed changes:

- **Paper selection:** The choice of authors, as distinguished from convention speakers, would continue to be made on the basis of abstracts, and all selected papers would be published in the convention proceedings, available to attendees at the time of registration. However, selection would be made by a national panel of experts for each technical sub-area, rather than by local groups. When the complete papers are submitted prior to the convention, this paper selection panel would pick the top 10% of the papers, based on their subject matter and its importance. Only these papers would be delivered orally at the convention. Each of the selected speakers would be given a full 45 min. or an hour to present his paper and to answer questions from the audience, instead of being shoe-horned into a brief 20 or 30 min. as at present.
- **Informal exchanges:** The remaining 90% of the convention authors would not be relegated to obscurity. Each would be assigned a 10-min. period during the convention for an informal question-and-answer session. Convention attendees who had read and were interested in a particular paper would be able to talk to the author during the allotted 10-min. period. If this period was not sufficient for questions, the group could adjourn to the corridors or other suitable spot and continue their discussion informally.

New Format Applied

Consider a typical convention which now runs for three days and presents a total of 120 papers, 40 per day.

This requires four simultaneous sessions each day with 10 papers per session, half of them delivered in the morning and half in the afternoon.

Applying the new format, the top 10% (12 papers) selected for oral delivery could be presented in a single session, six papers per day, over a two-day period. The authors of the remaining 108 papers could be scheduled for a 10-min. question-and-answer session during the same two-day period by scheduling two concurrent question sessions.

Instead of the original three-day convention, the activity has been cut to two days.

Instead of having four simultaneous paper sessions, there is but one oral paper session and two simultaneous question sessions.

The new format would not only slash convention time by one-third, but also provide additional time for the most significant technical papers. It would encourage the informal small-group discussion by bringing together engineers and scientists with similar interests at the scheduled 10-min. question-and-answer sessions.

Important By-product

There is an important by-product advantage.

The new format creates competition for the honor and distinction of being selected to deliver a paper orally, and this will do much to improve the quality of technical papers at conventions. Today with no competition and so many conventions, almost any one who writes a paper can find a convention somewhere that will let him deliver it.

(The recent Eastern Joint Computer Conference in Washington is one of the relatively few which exercises a high degree of selectivity in choosing papers to be delivered. This year of the 242 applicants, only 29 were selected to give papers. Selection was made by a panel of more than 80 specialists who reviewed summaries submitted by the 242 applicants.)

By adopting these much needed reforms, the technical societies can greatly increase the value and usefulness of technical conventions as information amplifiers.

Navy Contracts

Recent contracts awarded by the Navy within the aerospace industry:

Grumman Aircraft Engineering Corp., Bethpage, N. Y.—$67,907,436 for additional production of W2F-1 aircraft.

West Bend Co., West Bend, Wis.—$1,881,600 for rocket launchers for Zuni rockets.

A-C Spark Plug Division, General Motors Corp., Milwaukee, Wis.—$1,877,516 for inertial guidance components for Polaris missiles.

McKiernan-Terry Corp., Harrison, N. J.—$1,771,660, fixed price, for five gyroscopic stabilizers for Polaris submarines.

Technical Material Corp., Mamaroneck, N. Y.—$2.5 million, maximum liability, for 159 radio transmitters (AN/FR-39—AN/FRT-40), 30 modulators (AN/URA), and supporting equipment.

General Electric Co., Schenectady, N. Y.—$15,123,000, cost-plus-fixed-fee, for nuclear reactor components.

Lockheed Aircraft Corp., Plainfield, N. J.—$2,070,810, cost-plus-fixed-fee, for design, development and construction of service test model of lightweight long range early warning radar equipment.

Doehler-Jarvis Division, National Lead Co., Toledo, Ohio—$1,426,360 for underwater sound sources for anti-submarine warfare.

Sangamo Electric Co., Springfield, Ill.—$1,324,500, maximum price, redeterminable downward, for 15 sonar transducers with spare parts, technical data and reports.

Lear, Inc., Grand Rapids, Mich.—$2,999,982 for 2-in. stand-by Attitude Indicator Systems.

Aerojet-General Corp., Azusa, Calif.—$7,932,911 for design and development of the Mk.46 torpedo.

Massachusetts Institute of Technology, Cambridge, Mass.—$7 million for research and development work on the Polaris missile guidance system.

International Telephone and Telegraph Corp., Fort Wayne, Ind.—$2,028,950 for target detecting devices for Terrier guided missiles.

Sikorsky Aircraft Division, United Aircraft Corp., Stratford, Conn.—$24,555,510 for additional production of HSS-2 Sea King helicopters.

Ryan Aeronautical Co., San Diego, Calif.—$2,320,395 for Doppler navigation sets for helicopter installation.

Nortronics, Division of Northrop Corp., Anaheim, Calif.—$2,243,395 for research effort on changes to missile checkout equipment.

Electrics, Inc., Lompoc, Calif.—$1,199,921 for installation of range safety test communication cable plant at Naval Missile Facility, Point Arguello, and Vandenberg Air Force Base, Lompoc, Calif.

General Dynamics Corp., Electric Boat Division, Groton, Conn., $26,371,396; Bethlehem Steel Co., Quincy, Mass., $28,456,000; Ingalls Shipbuilding Corp., $29.5 million—all for production work on nuclear-powered submarines.

USAF Contracts

Air Force has recently awarded the following contracts:

Dayton Aviation Radio and Equipment Corp., Troy, Ohio—$1,409,698 for production of electronic equipment and spares for B-52 aircraft.

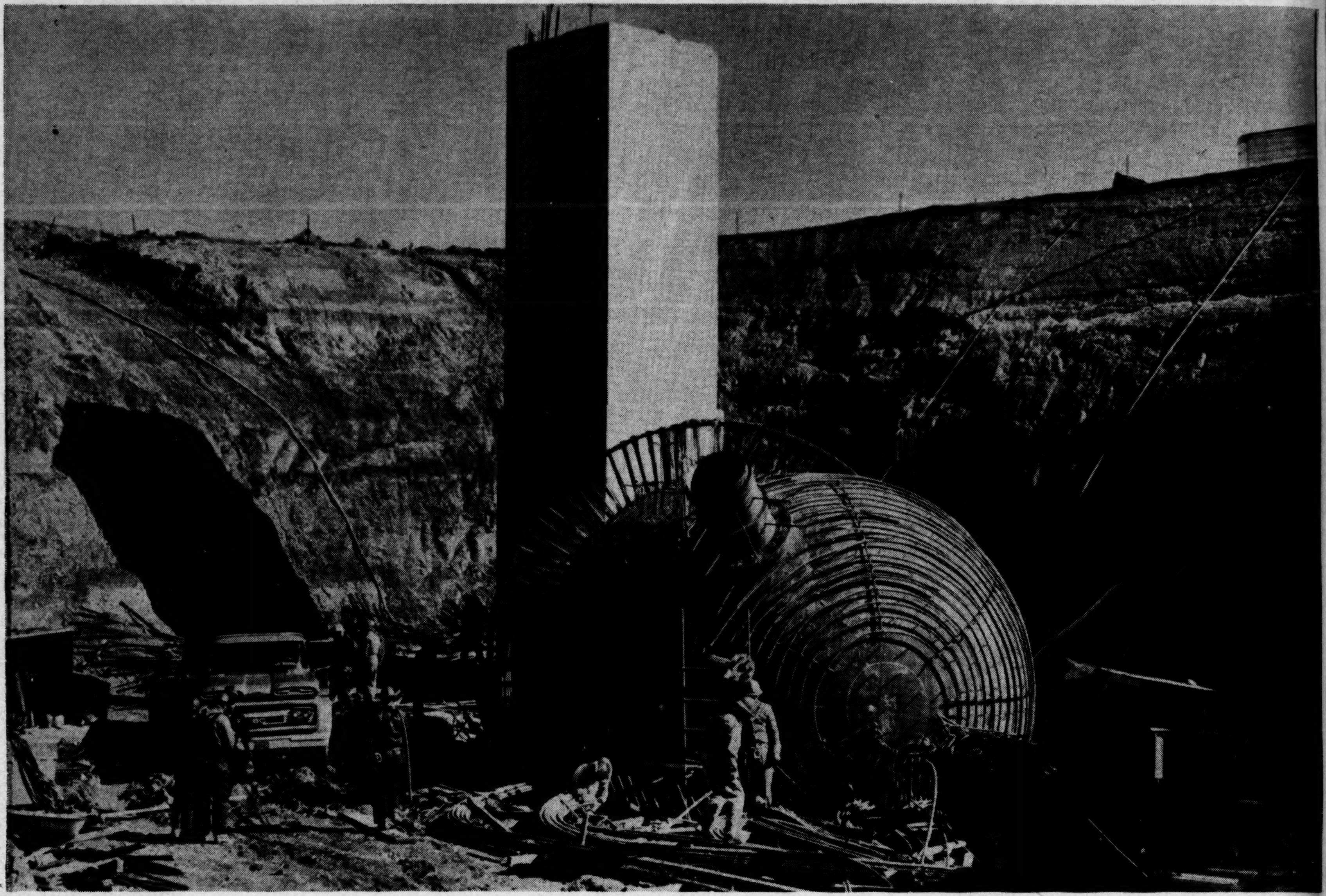
Magnavox Co., Fort Wayne, Ind—$3.7 million for radio sets and airborne transmitter-receiver sets.

Kaman Aircraft Co., Bloomfield, Conn.—$5 million for production of H-43B helicopters.

Fletcher Aviation Corp., El Monte, Calif.—$1,309,632 for fire bomb cases for napalm and similar materials.

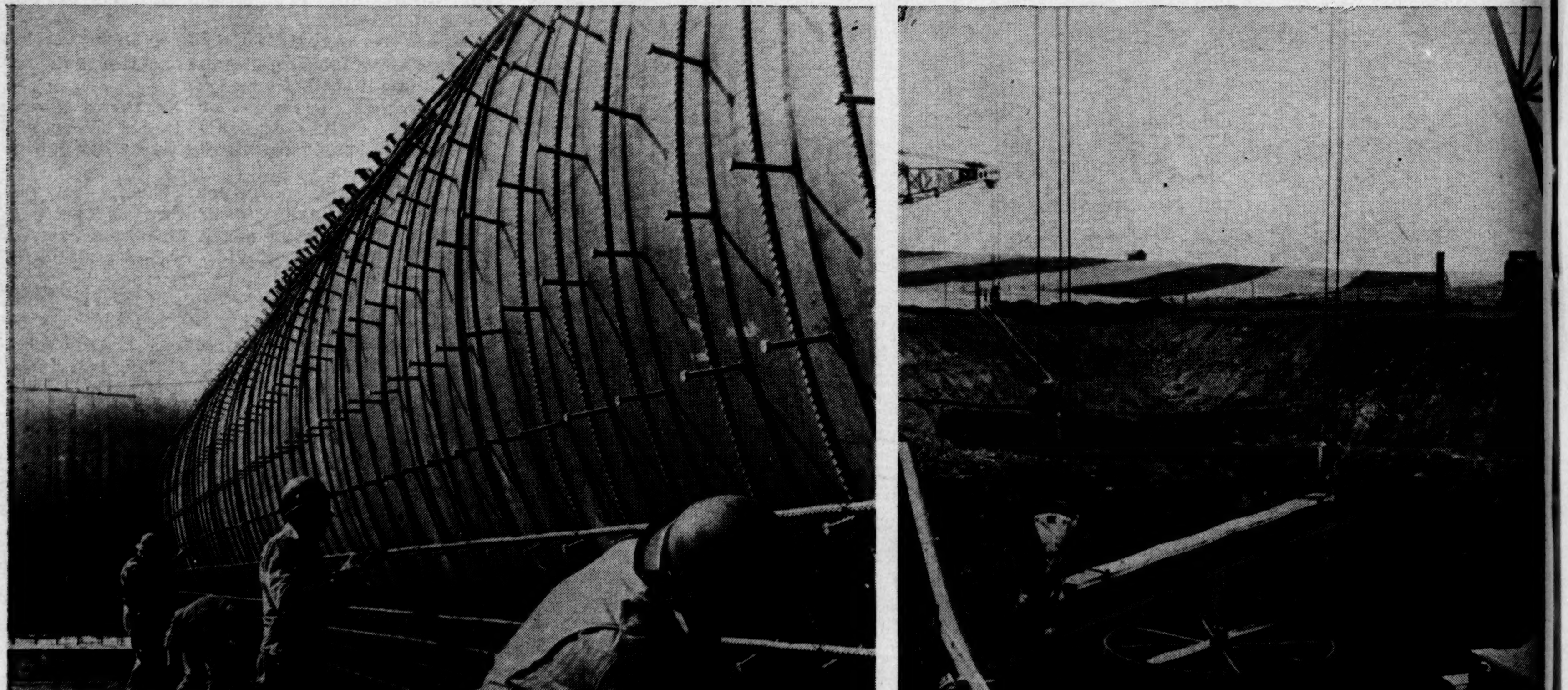
Texas Metals and Minerals Co., Orange County, Calif.—$1,188,080 for fire bomb cases for napalm and similar materials.

International Business Machines Corp., Rockville, Md.—$1,212,000 for production of components for the bombing-navigation system in B-52 aircraft.

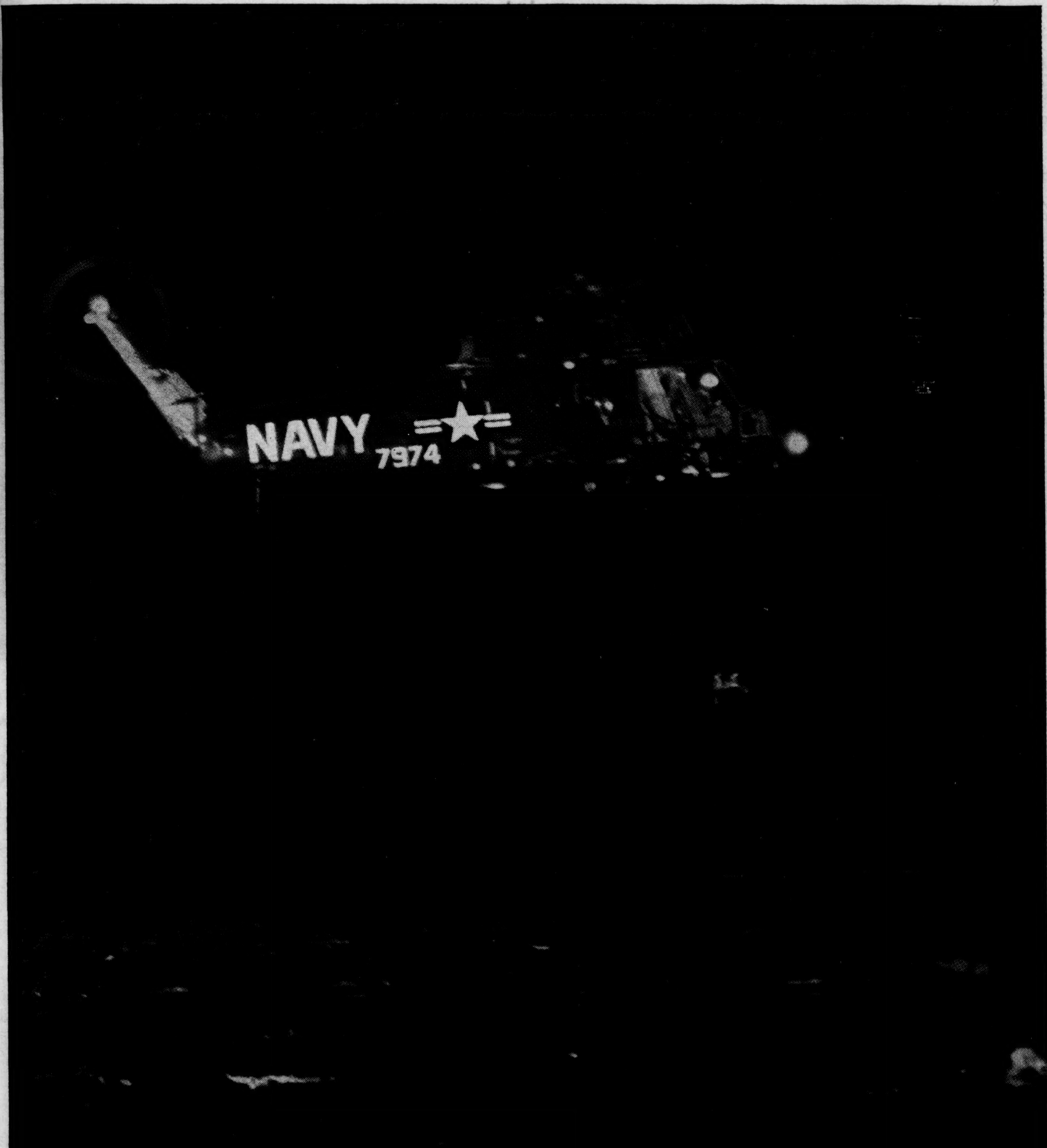


Minuteman ICBM underground launching complex at Malmstrom AFB, Great Falls, Mont., consists of 10 buried silo launch tubes surrounding underground control centers (steel and concrete chamber above). U. S. Army Corps of Engineers directs construction.

Minuteman Complex Being Built at Malmstrom AFB



Reinforcing steel is attached to lower missile tube (left); fabricated lower launching tube is placed in hole at right. Concrete will be placed around tube. U. S. Steel's American Bridge Division is erecting steel here under contract to Fuller-Webb Combine.



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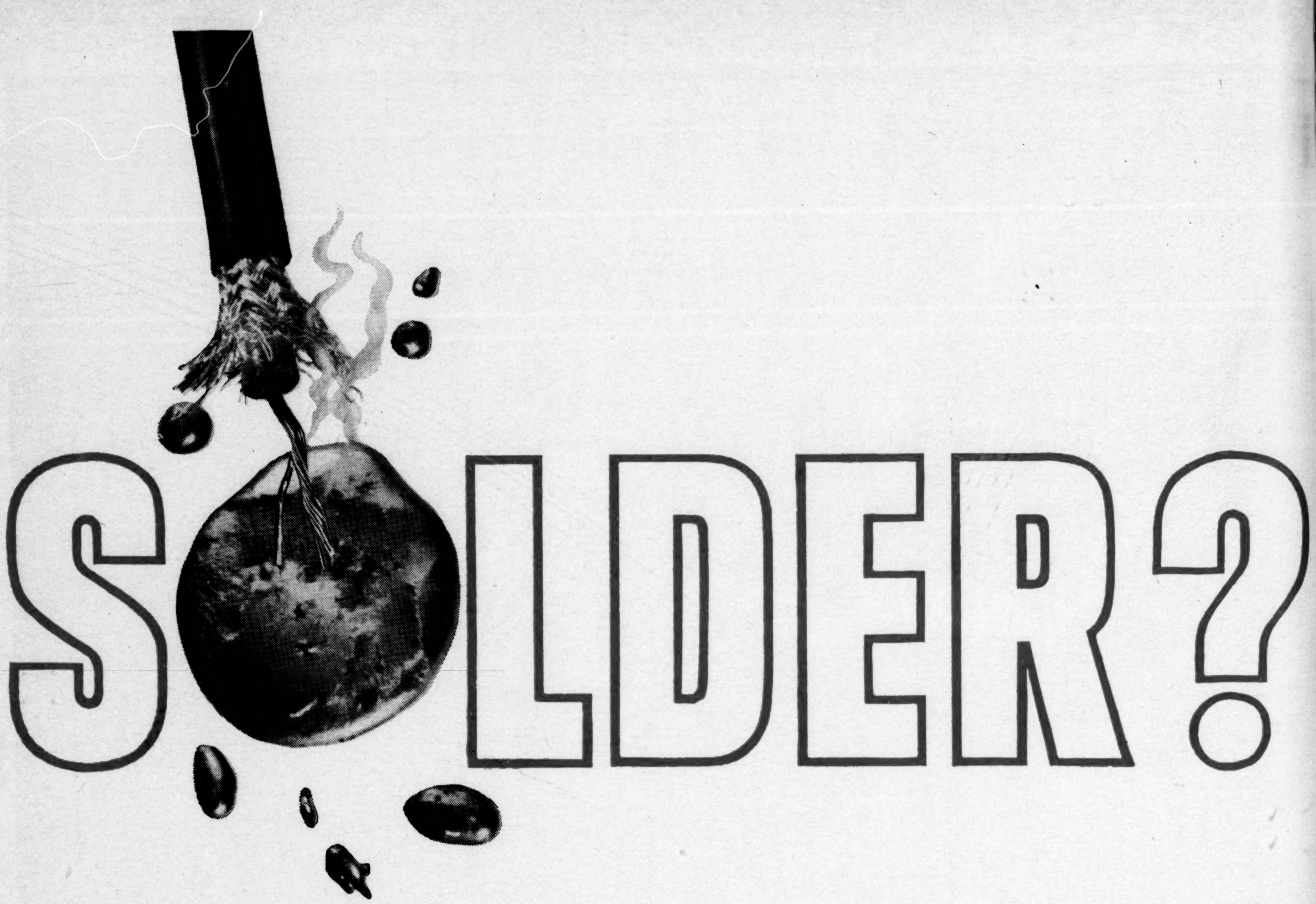
THE KAMAN AIRCRAFT CORPORATION, BLOOMFIELD, CONN.



FORGET IT! AMP has a crimp for coaxial connections

AMP rolled out all 20 years of its initiative in solderless termination techniques to meet the double challenge of coaxial wire termination. The goal: get rid of the solder; get rid of the double danger of burned insulation; get rid of the overtime in labor and costs; and measurably increase reliability.

AMP's new COAXICON* contact line gets rid of the solder. In its place, the COAXICON contact technique gives you the fastest, lowest-installed-cost crimped coaxial wire termination available anywhere in the industry.

One crimp does it—one stroke of an AMP tool attaches a COAXICON contact **simultaneously** to coaxial outer braid and inner conductor.

The COAXICON contact line has remarkable depth, for both single and multiple-connector applications. COAXICON contacts will accommodate the popular sizes of coaxial cables from RG 196/U to RG 62/U having stranded and solid conductors and have a very low VSWR in the KMC ranges when used with cables having a nominal impedance of 50 ohms.

Invite AMP COAXICON contacts to save you time and money on your specific coaxial application.

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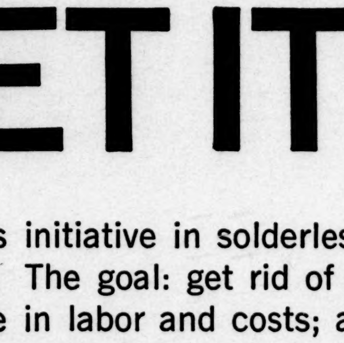
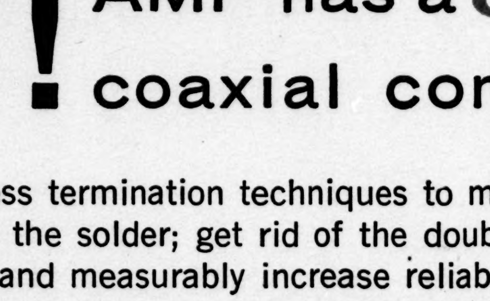
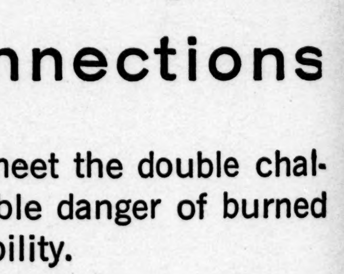

One crimp does it . . .


for multiple connectors . . .


or through-panel.

AVIONICS

Facility Will Assess Nuclear Vulnerability

By Philip J. Klass

Washington—First technical details on a new Pentagon facility which will explore new techniques for an advanced Department of Defense Damage Assessment Center (DODDAC) were disclosed here at the recent Eastern Joint Computer Conference.

The center is intended to provide the Joint Chiefs of Staff in peacetime with information on the nuclear vulnerability of armed forces and military resources of the U.S., its allies and potential enemies. In event of attack, DODDAC is intended to quickly determine the extent of nuclear damage experienced by friendly forces and resources as well as those of the enemy.

A first-generation, semi-automatic DODDAC equipped with an IBM 1401 computer, located at an undisclosed hardened site, went into operational use last summer.

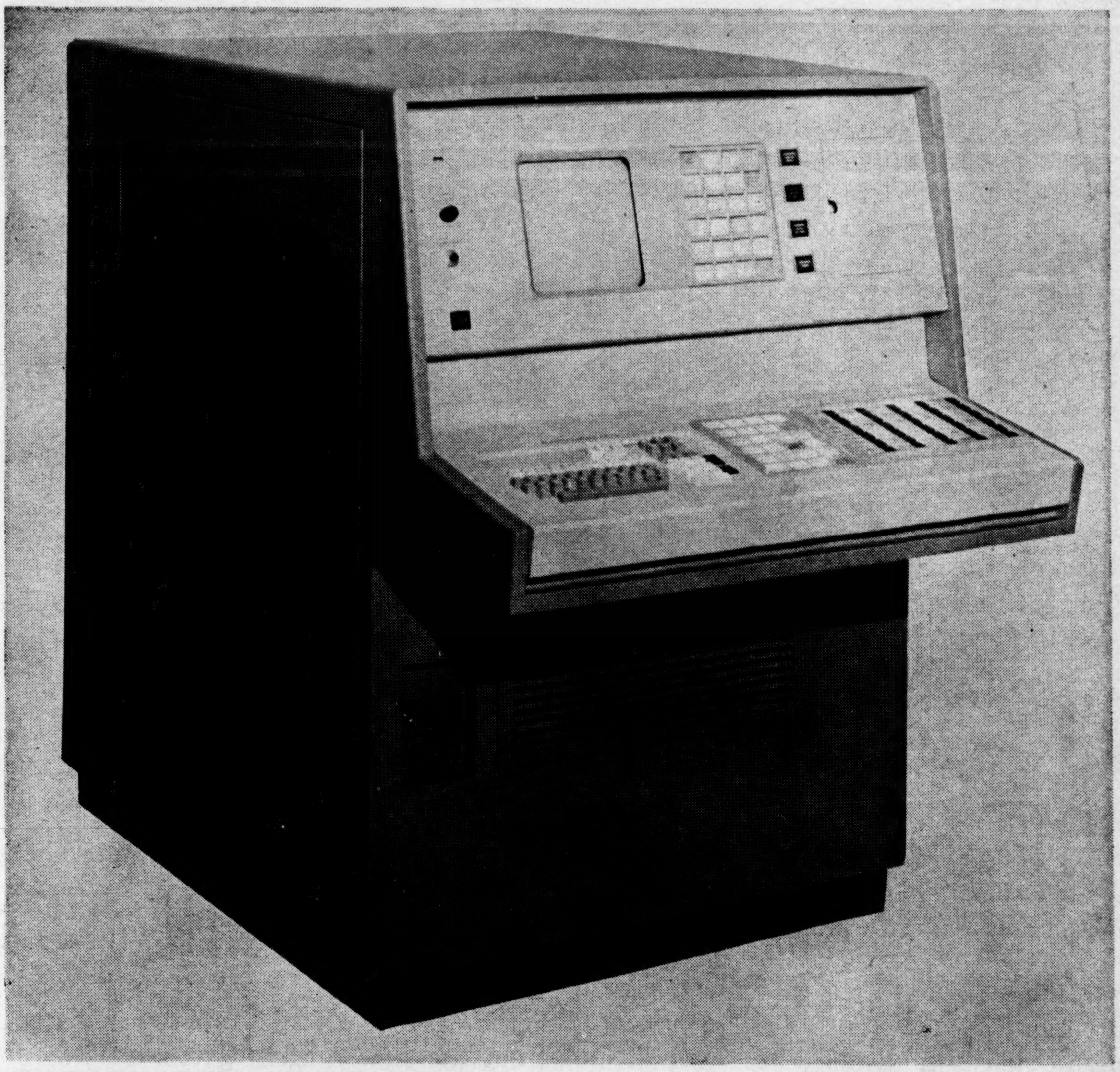
Development Center

The new DODDAC facility in the Pentagon will serve as a developmental center for trial of more advanced equipment and system concepts for a second generation Damage Assessment Center operational system to be implemented in the future. The new Pentagon facility will also be used for support of Joint Chiefs of Staff war game activities.

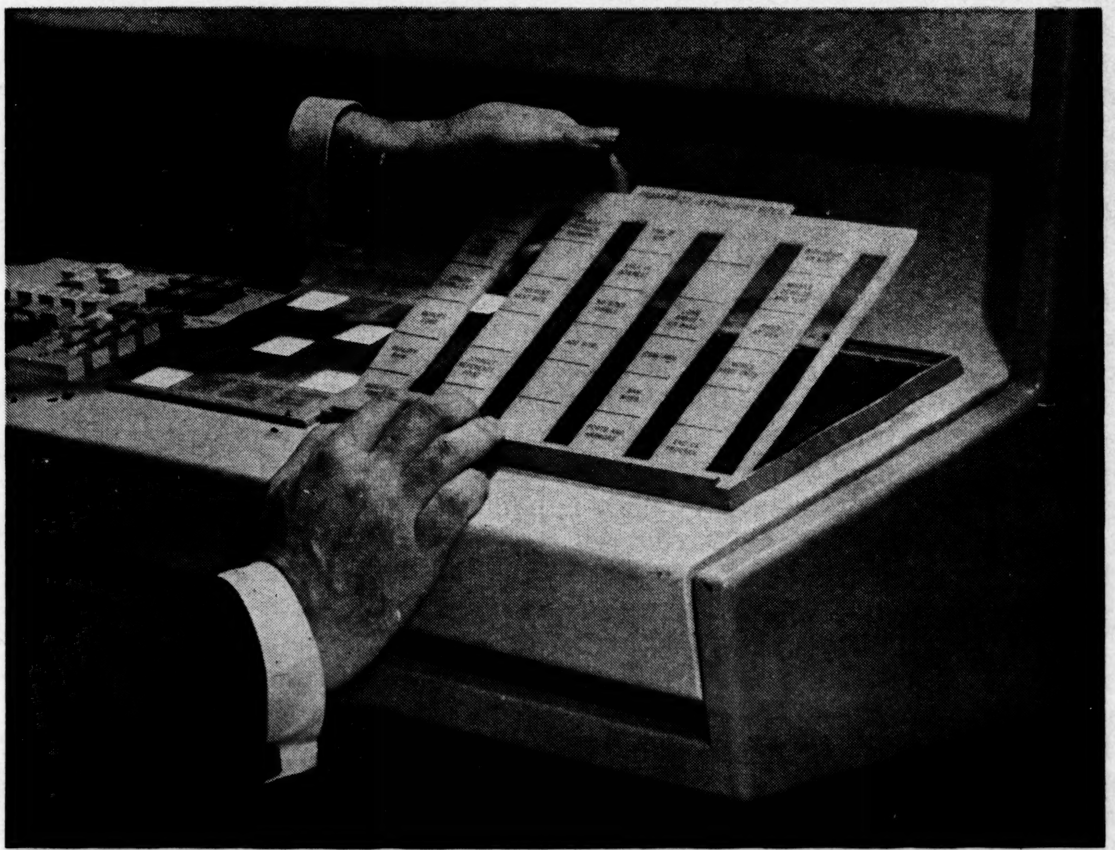
The DODDAC function, created about two years ago, is assigned to the Defense Atomic Support Agency (DASA), a joint services organization headed by Maj. Gen. Robert H. Booth, USA. DASA, which reports to JCS, is an outgrowth of the former Armed Forces Special Weapons Project, which in turn was the successor to the wartime Manhattan Project. Its other functions include responsibility for coordinating individual service requirements for nuclear weapons with the Atomic Energy Commission, providing technical liaison and assistance in operational tests of nuclear weapons, and disseminating information on nuclear weapon effects to the military services.

The new DODDAC development facility which is nearing completion here represents "a significant advance in large-scale data handling systems" and "one of the more advanced real time systems incorporating on-line interrogation and display," Dr. Walter F. Bauer of Thompson Ramo Wooldridge told the computer specialists attending the conference.

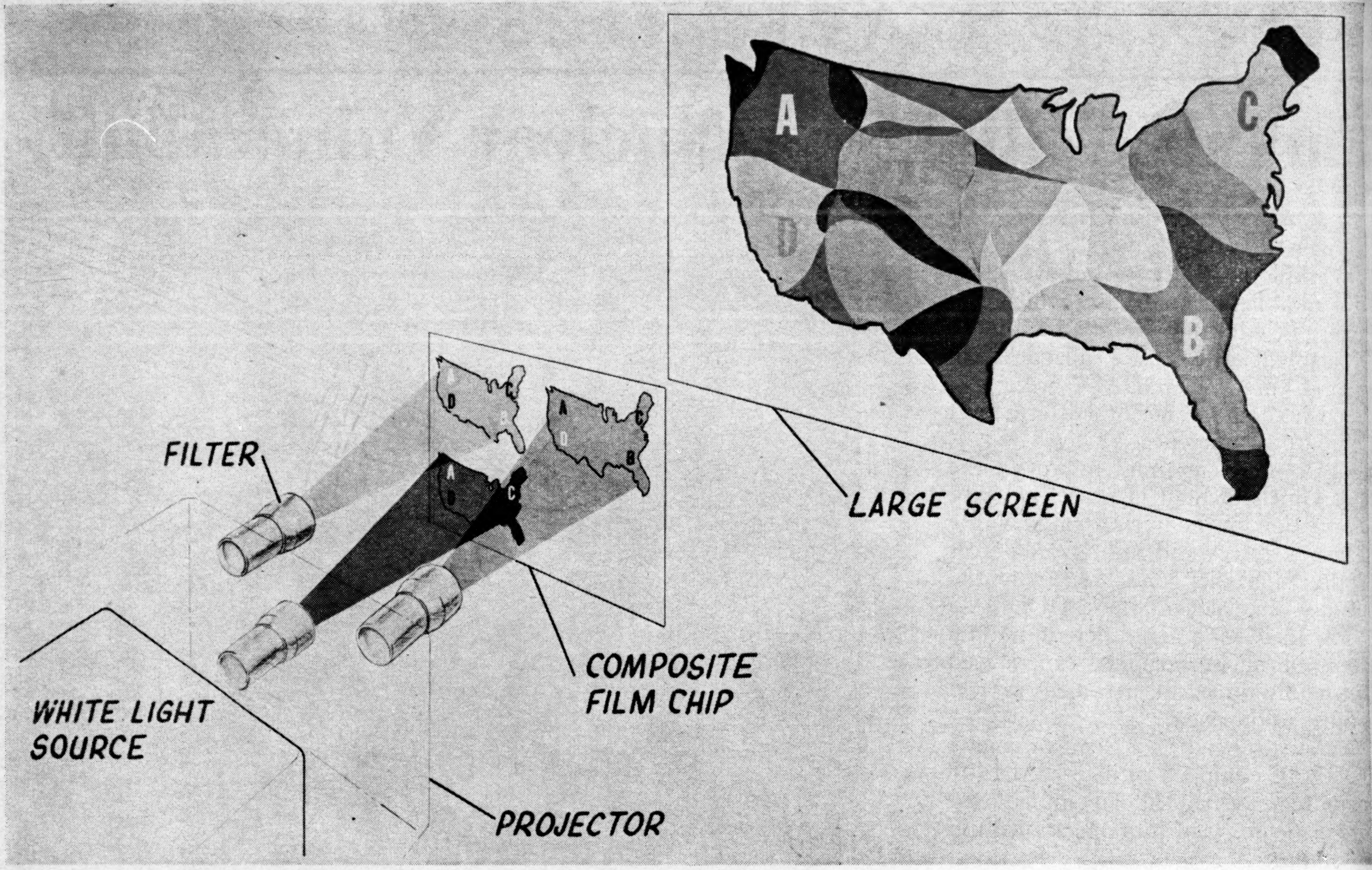
The company is responsible for providing the communication and display



COMPUTER COMMUNICATION console for Department of Defense Damage Assessment Center development facility will enable operator to communicate and interrogate complex CDC 1604 data processing system, consisting of a large central 1604 computer plus two smaller CDC 160 computers.



SIMPLIFICATION of communication console controls is made possible through use of 63 different plastic overlays, like one shown above, any one of which can be plugged in to alter computer routine and change functions of 30 pushbuttons on the console.



NEW DEPARTMENT OF DEFENSE Damage Assessment Center (DODDAC) development facility in Pentagon will use new type of dynamic situation display under development by Thompson Ramo Wooldridge. Full color display will be achieved using three separate images on black and white film chip.

equipment used in the new installation, including a new type of full-color dynamic-situation display.

The other two major contractors for the facility are System Development Corp., which is responsible for system modelling and programing, and Control Data Corp., which is providing the CDC 1604 data processing system. DASA is acting as system manager, awarding subcontracts for major elements of the new facility, according to Capt. Scott Lothrop, USN, deputy chief of staff for damage assessment systems.

Variety of Data

A vast variety of information on vital U. S., allied and enemy forces and resources of military interest will be collected, stored and kept updated in the DODDAC system. For example, information is collected on nuclear forces and their supporting resources, such as aviation fuels, air bases and support facilities—both mobile and fixed, including submarine harbors.

Capt. Lothrop emphasizes that DODDAC is not a command and control system, but it will be able to connect into and serve such systems, including the proposed national command and control system. Nor is DODDAC an intelligence system, although it will exchange information with existing intelligence systems.

The DOD Damage Assessment Center is designed to receive instantaneous reports from the existing national bomb alarm system. It will also receive data from the new nuclear detection system (477L), known as Nudets, when it is developed and implemented. Nudets is intended to pinpoint the location and approximate size of any nuclear blast occurring in the U. S. Weather information, which determines nuclear fallout patterns, also will be fed into DODDAC.

Information on strikes carried out by U. S. and allied strategic forces against the enemy also will be supplied to the center.

From such data, DODDAC must quickly calculate and display an assessment of the magnitude and consequences of damage upon the U. S., its allies, and the enemy. Such post-attack assessment will be an estimate of "degraded residuals"—the remaining forces and resources existing after attacks by both sides.

The DODDAC computers must be designed to accept such data as it is received, much of it over a time span of only a few minutes or hours, and to rapidly calculate the effects. The JCS staff must also be able to interrogate the system quickly to extract any of the vast amount of data that is stored there.

The console designed by TRW for communication with the CDC 1604 data processing system in the new development center is intended to enable the operator to function effectively as part of the system, Bauer said.

The console has a conventional alpha-numeric keyboard, control buttons and status lights to enable the operator to interrogate the system and select desired operating modes.

Employs Sub-routines

To minimize the number of buttons and controls on the console, the system employs sub-routines which generate displays for the console operator on a 10-in. cathode ray tube. For example, if the operator should push a console button requesting an assessment of damage to military installations, the computer automatically displays on the CRT a list of different types of military facilities. By pushing a button to move a marker on the CRT, the operator can select the specific type of interest.

Another feature intended to reduce the number of control buttons on the console is the use of 63 plastic overlays, any one of which can be placed over a bank of 30 control buttons. When a particular overlay is installed, with its particular selection of control options inscribed on the overlay, six prongs on the underside of the overlay automatically select the computer subroutine for the specific functions desired. By such means the 30 buttons can be used to provide a total of 1,890 control functions—(30 x 63).

The TRW approach to the design of an on-line group display, which is particularly well suited to DODDAC, may also find application to other military data processing system situation displays.

The display uses a 70 mm. film chip (slide) which can be projected on a 8 x 10 ft. screen. An unusual feature of the equipment is that it provides a full color display using black and white film, through a special separation process. The film can be developed through application of heat instead of chemicals in only 1½ sec., Bauer said.

Background Slides

From a library of previously prepared background slides, such as maps, charts or photographs, the system selects the desired one, superimposes current-situation information generated by the computer, and produces a new composite slide which is ready for projection within 30 to 60 sec., Bauer said. The extraction of the appropriate background, preparation of the new composite slide, and projection will automatically be controlled by the DODDAC data processing system.

The full color display is achieved by creating three separate black and white images on a single slide, using three filters. One image is produced by light which passes through a red filter, another by light passing through a green filter, and the third by light passing through a blue filter.

When the slide is projected, red, green and blue filters again are used to reconstruct the three images which then are optically combined to achieve full color.

The technique has the added advantage of preventing color mixing between the background and the computer-generated information. For example, if the background map is blue and the computer generates a yellow triangle to indicate a bomb blast point, the triangle appears yellow on the display screen, instead of mixing with the background to form a green triangle.

The center's data processing system employs a large CDC 160 computer plus associated input-output equipment. Much of the equipment at the new facility, such as the CDC 1604 system, is being rented to hold down facility costs and permit the use of more advanced equipment when and if it becomes available and needed.

A large random access storage, with a capacity of more than 30 million characters, is provided by a Bryant 320 disk file. It has a character transfer rate which ranges between 20 kc. and 62.5 kc., Bauer said. System is designed to permit storage to be increased to 100 million characters.

One of the two small CDC 160 computers normally serves as an input-output buffer and processor for data entry and hard copy output. The other CDC 160 operates in a time-shared arrangement, serving the large 1604, the communication console and controlling the processing of slides for the large group display. For certain types of simple operations, one of the small CDC 160 machines can be used independently.

The large 1604 machine performs the analytic and retrieval tasks required by the DODDAC development center, including computation of the damage assessment function, updating of stored information, and output processing. The machine's master program also controls the scheduling and direction of data flow throughout the system, including the two satellite 160 machines.

Unusual Aspect

The new system is unusual, Bauer said, in its ability to adapt the small CDC 160 computers for both "off-line" type operations and as computer partners in support of the real-time processing operation. The report by Bauer was co-authored by Werner L. Frank, also of Thompson Ramo Wooldridge, Canoga Park, Calif.

The new DODDAC facility, located in the basement of the Pentagon, is intended as a developmental center and its operational use is expected only for pre-attack hazard-vulnerability studies and simulated post-attack damage assessment, Capt. Lothrop said. It is not intended as a post-attack operational facility, a function which is performed by the present first-generation hardened installation.

ICAO May Adopt Improved Landing Aids

Washington—Changes in present instrument landing system (ILS) standards, to permit use of higher-accuracy facilities where needed for lower jet transport weather minimums, will be one of the important subjects considered next month in Montreal at the seventh session of the International Civil Aviation Organization's Communications Division.

The ICAO meeting opens Jan. 9 and is expected to continue until mid-February. The conference is not expected to produce the heated controversy of the previous meeting two years ago when the U. S. and the United Kingdom locked horns over the adoption of Tacan-compatible distance measuring equipment (DME) as an international standard.

Delegates from approximately 25 member states, including Poland and Czechoslovakia, are expected to attend. The Soviet Union, which is not an ICAO member, may send an observer to the meeting.

The U. S. delegation will be headed by Dr. P. D. McKeel of the Federal Aviation Agency. McKeel is acting chief of the System Staff Division in FAA's Aviation Facilities Service.

The present ILS international standard, adopted some years ago, is considered adequate for many areas and airports and therefore will not be changed as such. However, ICAO will consider the addition of one or possibly two new categories of ILS standards, incorporating such recent developments as the improved accuracy directional localizer for implementation and use at high density airports serving jet aircraft.

New ILS Categories

The new ILS standard categories, if adopted, will be operationally compatible with the present standard in that aircraft equipped to use conventional ILS will also be able to use the new facilities.

A similar addition to the present VOR (omnirange) navigation aid standard will be considered to permit use of the recently developed Doppler-type VOR which can be employed in adverse-site locations where a conventional omnirange station would have excessive errors.

Another subject of considerable interest will be aircraft identification (radar) beacons. After extensive discussions between the U. S. and United Kingdom, to resolve differences over what sidelobe suppression technique should be used—differences which arise because the British segregate civil and military air traffic while the U. S. generally does not—the two countries agreed upon a dual-standard of sidelobe suppression.

This will require international operators flying into the United Kingdom and the U. S. to carry radar transponders equipped for both sidelobe suppression techniques, while domestic aircraft operating entirely within either country can be outfitted with a beacon providing only one suppression mode.

The modest weight and price penalty which results for international operators who must carry dual suppression mode beacons was considered less objectionable than other alternatives. This dual sidelobe suppression type radar beacon will be proposed as an international standard at the Montreal meeting.

There will be an exchange of views,

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but no attempt to adopt an ICAO standard, on the related subject of automatic altitude (height) reporting via the beacon.

The Montreal conference also will consider the possible need for additional VOR and DME channels as a means of providing additional airways in high-density areas. It appears technically feasible to double the effective number of VOR channels by introducing 50-kc. channel spacing instead of the present 100-kc. spacing. A similar increase in the available number of DME channels could be obtained by adopting a second pulse coding arrangement for interrogation of the DME ground station and for its response.

The ICAO conference will consider the desirability of this approach, which would require modification, or in some instances replacement, of existing ground and airborne equipment.

An alternative way to provide additional airways without channel splitting, which may be considered, is the use of off-course computers and pictorial displays.

Channel-Splitting

The consequences of channel-splitting are most acute for the U. S., because of the large number of private fliers who strongly oppose changes that force replacement of their existing communication-navigation equipment.

Another item on the ICAO agenda is the question of establishing acceptable minimum performance requirements for airborne communication and navigation equipments as an international standard. Because of the relatively few small private aircraft operated in most ICAO member states, there is expected to be considerable support for such a move. But the U. S. is expected to seek standards which are not incompatible with the domestic needs of private aviation.

Long-distance navigation aids are scheduled as an "exchange-of-views" item on the Montreal agenda, to be followed late next year with a special ICAO meeting to consider adoption of an international standard.

Doppler Reference

The U. S. delegation is expected to indicate a preference for Doppler radar, which is finding increased use by international operators, when used with a suitable automatic navigation computer and an accurate gyro heading reference, rather than a new ground-based system.

When Loran position fixes or star sights are used to periodically correct a Doppler navigation system, it can provide satisfactory service as a long-distance navigation aid, with no new investment in ground facilities, the U. S. delegation is expected to stress.

But when ICAO delegates exchange views on the possible use of a Dopp navigation system as a short-distan navigation aid, the U. S. delegation expected to voice doubts over its u fulness, particularly in high-dens terminal areas.

Although the U. S. Air Force been a pioneer in the application single sideband techniques to lo range high-frequency radio communi tions, particularly for ground-air co munications, the U. S. delegation is expected to strongly urge the adopti of single sideband (SSB) as an int national standard.

Current thinking is that the use very-high-frequency (VHF) troposphe scatter, which nearly doubles t normal line-of-sight range of VHF, m be a better solution to present HF rad communication channel congestion ov the North Atlantic. The technique w pioneered for ground-air use by P American World Airways, and the Fe eral Aviation Agency currently is i stalling two additional tropo-scatt stations which should provide near continuous VHF coverage of the Nor Atlantic airline routes.

FILTER CENTER

▶ **USAF to Develop Nuclear Gyro** Aeronautical Systems Division is seeki organizations with capability of inves gating and demonstrating feasibility of nuclear gyro using nuclear spin ph nomena as basic reference. Sperry Gyr scope Co., which has been conducti nuclear gyro investigation with compa funds, is one of several companies e pected to submit proposals. Intereste avionics companies should contact G. Angelos, Wright-Patterson AFB, Da ton, Ohio. Other upcoming ASD r quests for proposal for avionics researc and development include:

- **Creature communications:** Study basic mechanisms and processes of livin creature sensors, adaptive filtering an neural processes for possible applicatio to Air Force communication syste needs. Bidders briefing conference scheduled for Jan. 3. RFP: 33-657-6 5378-Q. Contact: ASKPDC, CL- 7111, Ext. 3-1396.
- **Redundancy reduction memory de vice:** Research and development o memory device capable of performin both storage and logical functio within itself for use in future telemetr systems. RFP: 23-657-62-5381-Q. Co tact: ASKPDC, CL-3-7111, Ex 3-1396.

▶ **USAF Official Warns Industry**—A Force presently is seeking reliable mean for identifying the consistently ef cient contractors, so that they may b rewarded appropriately, and to dete the consistently inefficient contractors so that we may sever relations with them," Maj. Gen. Kenneth P. Bergquist, Air Force Electronic Systems Division commander, warned at recent Chicago meeting of Armed Forces Communications Electronics Assn.

▶ **Army Plans Active Thin-Film Program**—Research and development program aimed at developing thin-film active elements by means of epitaxial overgrowths of silicon on polycrystalline substrate surfaces is planned by Army Signal Corps. Industry proposals are due early in January.

▶ **Increased Radar Sales Predicted**—Market for surface, shipboard and airborne radar, currently estimated at approximately $740 million annually, is expected to increase by more than 50% to approximately $1,135 million by 1970, according to predictions made at recent Electronic Industries Assn. Winter conference in Los Angeles. Sales of heavy surface radar, currently running at annual volume of about $500 million, are expected to reach $775 million by 1970, A. H. Skaggs of Radio Corp. of America said. Increased sales for ICBM defense and space surveillance will be responsible for majority of the anticipated gain. Shipboard radar sales are expected to increase from $110 million to $150 million in 1970, according to Clifford A. Bean of Raytheon. Sales of airborne radar for manned aircraft and drones, currently running at $127 million level, are expected to decline to about $82.5 million in Fiscal 1966, but then rise to $215 million by Fiscal 1970, according to prediction by G. P. Page of Motorola.

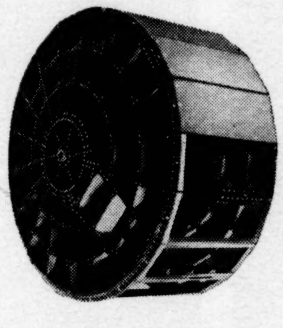
▶ **Soviets Study Gravitational Waves**—Two Soviet scientists recently proposed an experiment which might permit detection of gravitational waves. Technique involves use of two groups of 20,000 identical, closely packed parallel cylinders which would be caused to oscillate at a frequency of about 10 cps. A shift in the phase of oscillation of one group of cylinders is expected to cause a synchronous change of gravitational radiation emitted by the other. This would result in a modulation effect which could be detected by measuring the amplitude of the voltage across both groups of cylinders simultaneously. Details of the proposed experiment are described in an article by V. B. Braginskiy and G. I. Rukman in the Zhurnal eksperimental 'nov. i takhnicheskoy fiziki, Vol. 41, No. 1 (7), 1961, p. 304.

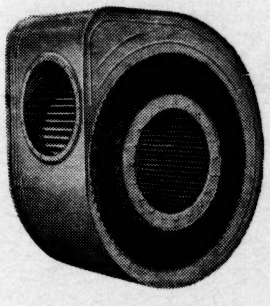
▶ **Collins Forms Emergency Service Center**—A new customer emergency service center, which will remain open 24 hours per day, 365 days a year to provide immediate response to military/commercial customer problems, has been established by Collins Radio Co. at its Cedar Rapids, Iowa, headquarters.

▶ **Commercial ADX**—Automatic data exchange system which routes messages of various speeds and codes, ranging from 60 word per minute teleprinter traffic to thousands of bits per second data channel traffic, has been developed for commercial use by ITT Systems Division, Paramus, N. J. System automatically routes messages, establishes message priority, stores messages when receiving channel is in use, and reconciles speed and code differences between transmitting and receiving equipment.

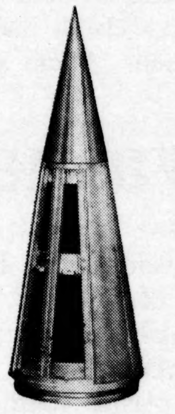
▶ **Physiological Data Transmitters**—Minute radio transmitters for implanting in living animals will be designed for the Air Force School of Aerospace Medicine by RF Communications Associates, Inc., Rochester, N. Y. Devices, powered by self-contained batteries and modulated by bioelectric potentials, will provide telemetry equipment in space vehicles with continuous data on heartbeat, blood pressure, temperature and other physiological parameters for periods up to 30 days.

A REPUTATION BUILT ON EXPERIENCE


TIROS STRUCTURE


HEAT EXCHANGER

Components built by Lavelle have met the challenge of change in the aerospace industry for more than two decades. You can rely on this proven experience in making sheet metal parts and assemblies to exacting specifications—for missiles, jet engines, space vehicles and airframes . . . electronic systems and equipment for ground support.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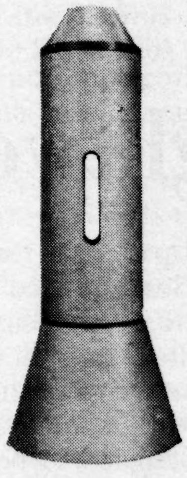
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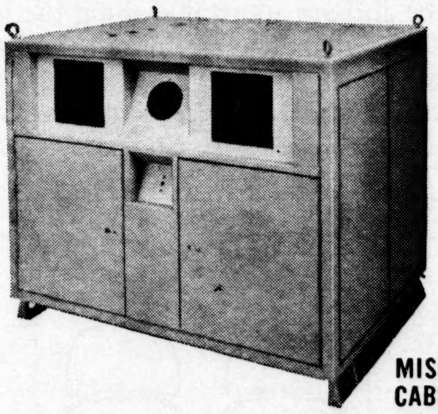
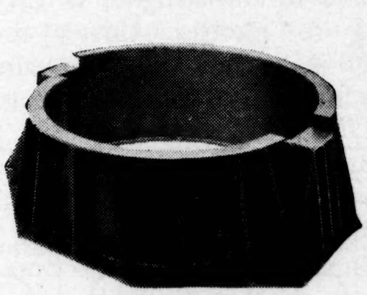

MISSILE SUPPORT CABINET


RADAR PEDESTAL BASE

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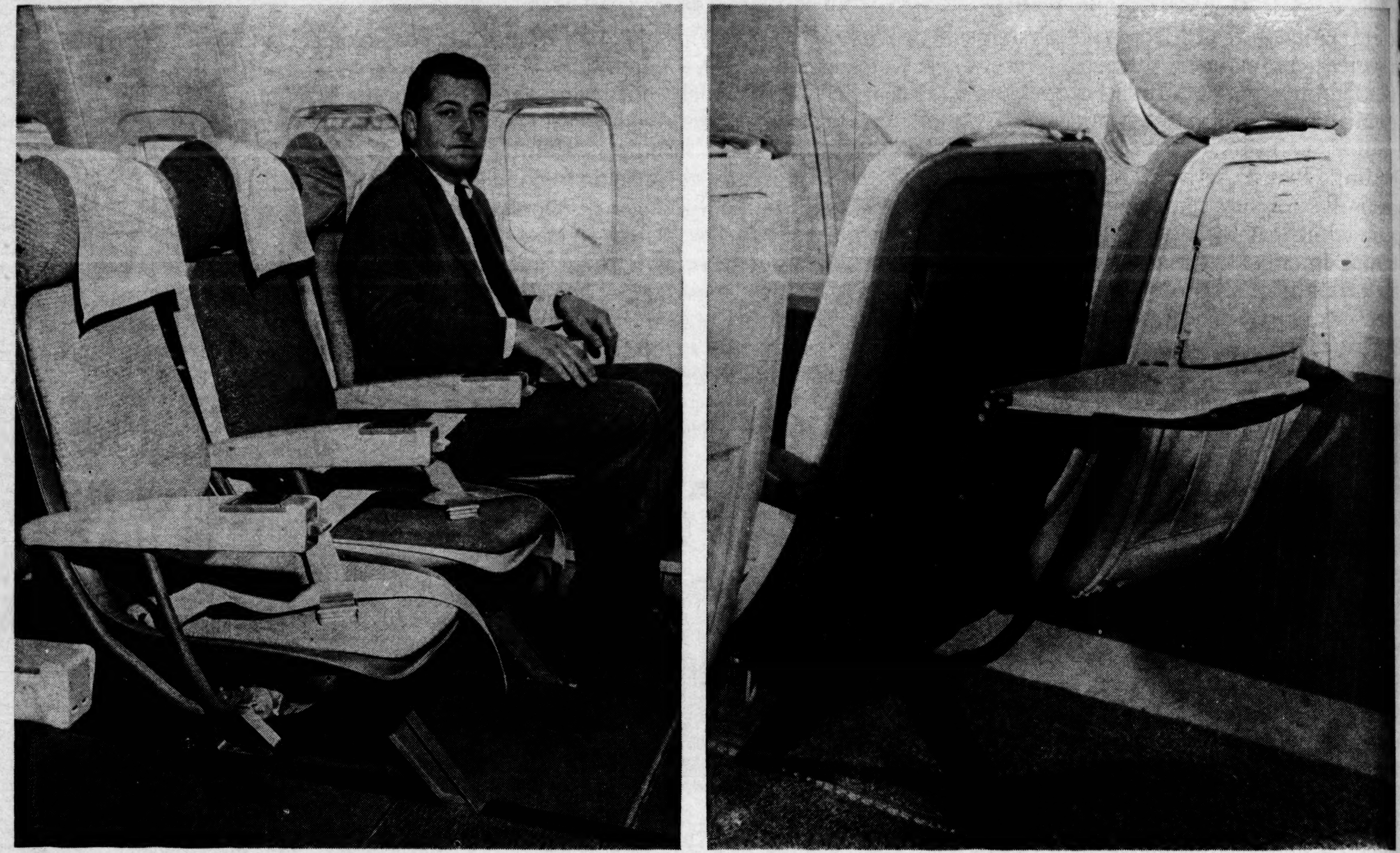


MASON SEATS, ordered by Continental Airlines and being evaluated by both American and TWA, have cushions glued to Mylar plastic shell and covered with removable seatcovers. The manufacturer claims maintenance savings of more than 50% over conventional seats are possible. Integral table is of plastic foam construction. Photo at left shows American's installation for inflight tests.

Lightweight Seat Evaluated by Airlines

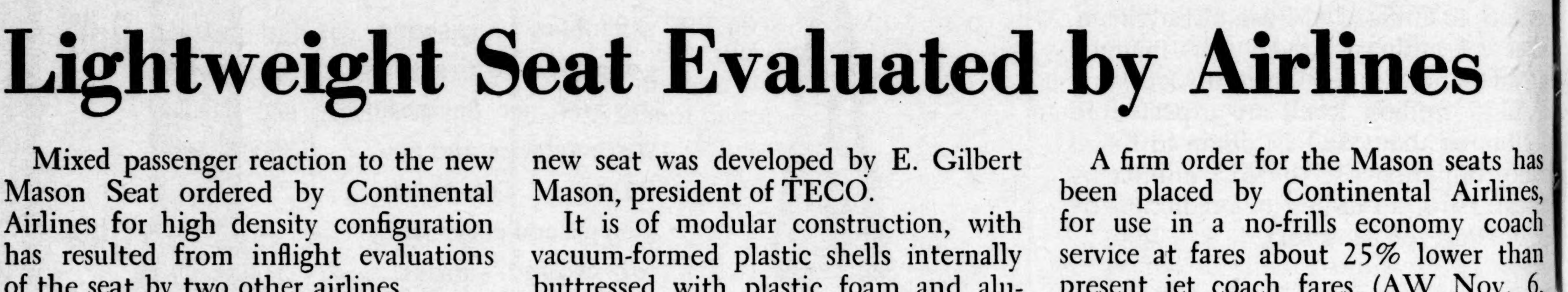
Mixed passenger reaction to the new Mason Seat ordered by Continental Airlines for high density configuration has resulted from inflight evaluations of the seat by two other airlines.

The seat, manufactured by TECO, Inc., is designed to be simpler, less expensive, and lighter than conventional seats and to allow higher density cabin seating to increase carrier revenues. TECO is a California company that builds conventional airline seats. The new seat was developed by E. Gilbert Mason, president of TECO.

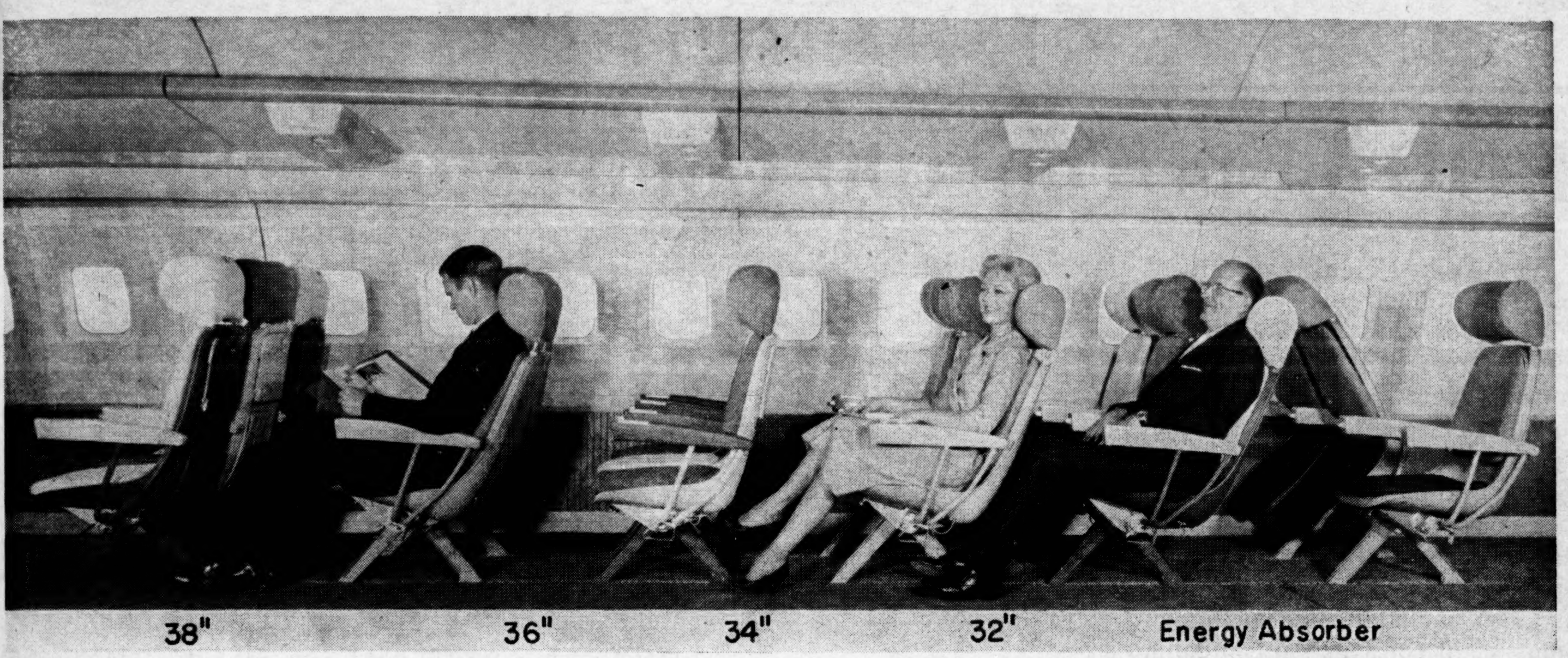
It is of modular construction, with vacuum-formed plastic shells internally buttressed with plastic foam and aluminum structure. Armrests, shells and legs fit onto an aluminum support tube and are adjustable along the length of the tube. The contoured shell allows thinner cushioning, and is calculated to permit 4- to 5-in. space saving between rows of seats.

A firm order for the Mason seats has been placed by Continental Airlines, for use in a no-frills economy coach service at fares about 25% lower than present jet coach fares (AW Nov. 6, p. 37). Continental's application to provide this service has been rejected by Civil Aeronautics Board pending investigation. It was to have been effective Dec. 1.

There is some uncertainty about the size of Continental's order. The airline



SEAT DIMENSIONS AND SPACING show differences from conventional seat spacing. The seats rotate forward through 62 deg.



MOCKUP OF AIRLINER INTERIOR by TECO shows how spacing between rows of seats may be varied. Similar spacing between rows, using different space allotments, brought forth varied reactions in American Airlines flight tests. Passenger complaints tended to increase as space between rows decreased. Note energy absorption action of seat on row at right.

has announced the purchase of 375 seats, but some reports place the order higher. Continental will not discuss its commitment beyond the announced 375. The airline planned to equip five Boeing 707-120s with the seats, providing 75 economy jet seats per airplane, plus 36 regular club coach seats and 44 first class seats of conventional design. The Mason seats would be spaced at a 32-in. pitch.

American Airlines and Trans World Airlines, both of which opposed the Continental fare but filed for it anyway to meet the competition, have run their own evaluations of the seats. In both cases these involved tests on actual scheduled flights with surveys of passenger reaction. Continental planned surveys after start of the service, but has not tested inflight so far.

American and TWA report mixed passenger reaction to the seats. The results still are being evaluated.

TECO said the seat weighs 26 lb. compared with 33 lb. for a standard coach seat. First class seats run about 50 lb. or more. With an all-Mason-seat configuration accommodating 189 people in a 707, the weight would total about 300 lb. more than standard seats for 80 coach and 40 first class, according to TECO.

The Mason Seat is said to have strong maintenance advantages. It has only 70 parts versus about 600 for a conventional seat. Cushions, which are attached to the shell by adhesive and can be peeled off, have removable covers. The Mylar plastic shells can easily be cleaned with soap and water, according to TECO. Legs are quickly detachable from support tubes. The legs are aluminum forgings with quick disconnect cap. The manufacturer says maintenance cost savings of more than 50% are possible with the new seat.

Leg room is uncluttered and there is an 8½ in. provision for underseat stowage of baggage. The seat's headrest rotates fore and aft and is adjustable in three vertical positions. Integral table is of plastic foam construction. A continuous keyway along the structural tube allows unlimited adjustment of shell, armrest and leg components.

From a safety standpoint, the seat has successfully been tested to Air Transport Assn. standards. It features an energy-absorbing device which dissipated energy by the deformation of metal as the seat rotates through 62 deg. Tests are said to have been made to 30g at .05 sec. and 20g at .10 sec.

The manufacturer says the modular design of the seat offers great flexibility for installation in various types of aircraft. Parts are interchangeable in single, double and triple seat configurations.

Cost of the Mason Seat is about $1,200 for a triple version. This is said to compare with $1,600 for the least expensive conventional seats now used in Boeing jets and with $4,400 for a double first-class seat used in Douglas DC-8s.

In its evaluation of the seats, TWA installed two rows of three seats each on the right hand side of a 707. Passengers were given questionnaires. Two test programs of about 90 days each recently were completed. Results of the survey are still being evaluated, but indications are that public reaction was mixed.

American also recently completed its testing, which lasted about a month. Three rows of six seats each were installed on a 720B and passengers received questionnaires. Passengers in standard seats also were queried. Spacing was varied, starting at 37 in., moving down to 35 in., 34 in., 32 in.

As spacing decreased, American found complaints increased. Whereas reaction generally was favorable at the greater spacing, when spacing was reduced people began complaining about items that hadn't bothered them before, according to the airline. There was some resistance to the styling of the seats, which are of striking contemporary design compared with the conventional seat and apparently don't appeal to people with conservative tastes.

Generally, American found that the conventional seats fared better than the Mason seats in the survey.

As a result of the airline tests, serving tray supports on the seats have been modified to overcome a wobble. No other changes have been made. The serving tray problem was known to TECO, but the fix had not been accomplished before the evaluations.

Except in the airbus version, the Mason seats recline. A lock on the reclining position is available to the customer as an option. In the standard version, a spring dampener is included. Continental has elected to buy the seats without a reclining lock pin.

The seats also are being tested by Greyhound Bus Co., which is equipping two buses with 38 seats each.

Other Mason seat projects now in the works include a seat with leg rest for coach cabins featuring a 45 in. pitch, and a triple seat with a removable center seat which can be converted to a table with the armrest removed. This can be done by the passenger in the event the cabin is not sold out.

Mason also is considering a plan to lease seats to airlines through a leasing company. This would involve finding a neutral color pleasing to all, with interior color schemes varied by different cushion covers.

DOD Lists Top 100 Contractors in 1961

New York—Defense Department's list of 100 military prime contractors for Fiscal 1961 (July 1, 1960 to June 30, 1961) shows that the principal type of contract work for 62 contractors was for research, development, test and production of missiles and space vehicles, aircraft and electronics.

The electronics work was in the main related to aircraft and missile systems, or to control and warning systems. The list also includes nine petroleum refiners, eight construction companies, six tank or automotive companies, six transportation or service companies, five shipbuilding concerns and four ammunition-chemical production companies.

General Dynamics Corp. tops the list for the fourth time in five years (AW Dec. 11, p. 38). The 100 companies and their subsidiaries received a total of $17.3 billion in contracts out of a total of $22.7 billion awarded by the United States in Fiscal 1961.

There are 21 companies on the 1961 list that were not on the 1960 list, disregarding companies which changed their names. Construction firms accounted for most of this turnover. The major portion of construction is in the building of missile bases. Aircraft companies are reduced by three and missile companies have increased by four, reflecting the long-term trend toward space vehicles and missiles and away from aircraft.

The 100 companies and their subsidiaries are:

Companies	Millions of Dollars	Per Cent of Total
1. GENERAL DYNAMICS	1,920.1	8.5
Freeman Coal Mining Corp.	*	†
Total	1,920.1	8.5
2. NORTH AMERICAN	1,197.4	5.2
3. LOCKHEED AIRCRAFT	1,133.0	5.0
Grand Central Rocket Co.	1.5	†
Lockheed Air Terminal Inc.	0.7	†
Lockheed Aircraft International, Inc.	6.9	†
Lockheed Aircraft Service, Inc.	20.2	0.1
Lockheed Electronics Co.	10.0	0.1
Puget Sound Bridge & Dry Dock Co.	2.9	†
Total	1,175.2	5.2
4. BOEING CO.	918.3	4.1
Allied Research Assocs.	1.5	†
Total	919.8	4.1
5. GENERAL ELECTRIC CO.	874.6	3.8
International General Electric Puerto Rico, Inc.	*	†
Total	874.6	3.8
6. MARTIN CO.	691.8	3.1
7. UNITED AIRCRAFT CORP.	624.6	2.7
United Technology Corp.	0.9	†
Total	625.5	2.7
8. AT&T	7.1	†
Chesapeake & Potomac Tel. Co.	1.1	†
Teletype Corp.	8.1	0.1
Western Electric	534.3	2.4
Total	550.6	2.5
9. SPERRY RAND CORP.	401.7	1.8
Vickers, Inc.	6.3	†
Total	408.0	1.8
10. RCA	392.3	1.7
11. HUGHES AIRCRAFT CO.	331.2	1.5
12. IBM	329.4	1.4
Service Bureau Corp.	0.6	†
Total	330.0	1.4
13. WESTINGHOUSE ELECTRIC CORP.	307.6	1.4
Bryant Electric Co.	0.1	†
Total	307.7	1.4
14. DOUGLAS AIRCRAFT CO.	307.4	1.4
Astropower, Inc.	*	†
Total	307.4	1.4
15. RAYTHEON CO.	303.7	1.3
Machlett Laboratories	1.1	†
Sorenson & Co., Inc.	0.1	†
Total	304.9	1.3
16. REPUBLIC AVIATION	295.7	1.3
17. GENERAL TIRE & RUBBER	25.9	0.1
Aerojet-General Corp.	261.7	1.2
Aerojet-General Nucleonics	0.8	†
Byers (A.M.) Co.	0.5	†
Space Electronics	0.9	†
Stauffer-Aerojet Chemical	0.4	†
Total	290.2	1.3
18. NEWPORT NEWS SHIPBUILDING & DRY DOCK	290.2	1.3
19. GENERAL MOTORS	280.2	1.2
Ethyl Corp. ‡	0.5	†
Frigidaire Sales	1.1	†
Total	281.8	1.2
20. BENDIX CORP.	266.4	1.1
Bendix-Westinghouse Automotive Air Brake Co.	0.1	†
Cleveland Instrument	*	†
Sheffield Corp.	0.3	1.1
Total	266.8	1.1
21. AVCO CORP.	251.6	1.1
22. GRUMMAN AIRCRAFT	237.8	1.1
Dynamic Development	0.1	†
Pearson Corp.	0.1	†
Total	238.0	1.1
23. McDONNELL AIRCRAFT	219.9	1.0
24. THIOKOL	210.0	0.9
25. ITT	143.9	0.6
Federal Electric	55.8	0.3
International Electric	0.1	†
Jennings Radio Mfg.	0.2	†
Kuthe Laboratories	1.3	†
Mackay Radio & Telegraph	0.1	†
Royal Electric	0.1	†
Suprenant Mfg.	0.1	†
Total	201.6	0.9
26. STANDARD OIL CO. (NEW JERSEY)	0.0	0.0
Esso International	87.4	0.4
Esso Research & Engineering	2.2	†
Ethyl Corp.‡	0.4	†
Gilbert & Barker	*	†
Humble Oil	72.7	0.3
Jersey Production Research	0.2	†
Standard-Vacuum Oil§	4.7	†
Total	167.7	0.7
27. CHRYSLER CORP.	158.2	0.7
28. NORTHROP CORP.	144.8	0.6
Page Communications Engineers	10.8	0.1
Total	155.6	0.7
29. PAN AMERICAN WORLD AIRWAYS	127.4	0.6
Pan American-Grace	*	†
Total	127.4	0.6
30. AMERICAN MACHINE & FOUNDRY	119.8	0.5
Beaird (J. B.) & Co.	*	†
Total	119.8	0.5
31. PHILCO CORP.	118.8	0.5
32. HERCULES POWDER CO.	117.0	0.5
33. BURROUGHS CORP.	107.8	0.5
Control Instrument	3.7	†
Total	111.5	0.5
34. STANDARD OIL CO. OF CALIFORNIA	65.5	0.3
American Bitumuls & Asphalt	*	†
California Oil	11.0	0.1
California Research	0.3	†
California Tanker	*	†
California Texas Oil**	32.6	0.1
Total	109.4	0.5
35. AMERICAN BOSCH ARMA	107.6	0.5
36. CHANCE VOUGHT CORP.	102.5	0.4
37. COLLINS RADIO CO.	58.7	0.2
Alpha Corp.	35.2	0.2
Communication Accessories	0.1	†
Total	94.0	0.4

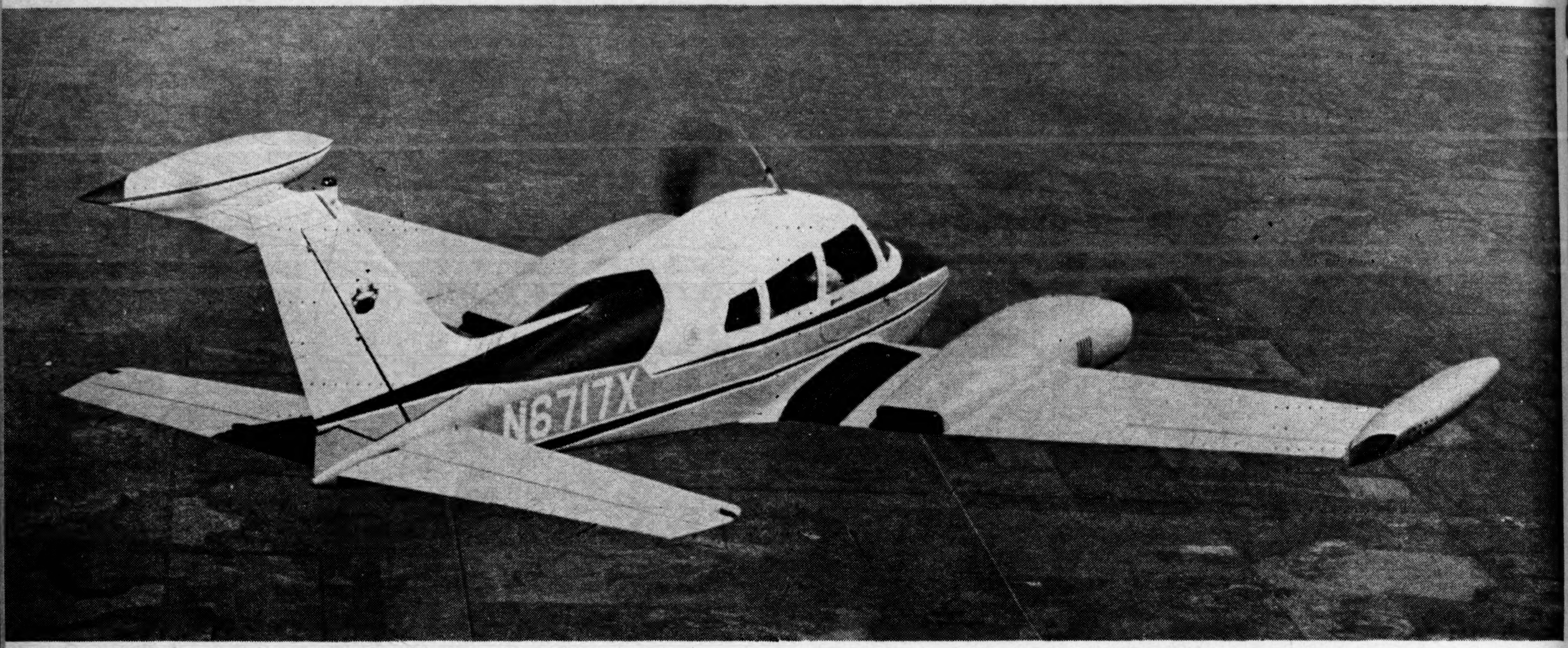
Companies	Millions of Dollars	Per Cent of Total
38. FMC CORP.	87.9	0.4
39. TEXACO, INC.	27.0	0.1
California Texas Oil**	32.6	0.2
Paragon Oil Co.	2.2	†
Texaco (Brazil)	0.2	†
Texaco Experiment	0.3	†
Texaco Puerto Rico	1.9	†
Texaco Trinidad	5.7	†
Texas Petroleum Co.	15.6	0.1
Total	85.5	0.4
40. MINNEAPOLIS-HONEYWELL	85.5	0.4
41. MIT	82.5	0.4
42. GENERAL PRECISION EQUIPMENT CORP.	0.0	0.0
GPE Controls	0.2	†
General Precision, Inc.	80.9	0.4
Graflex, Inc.	0.2	†
Strong Electric	*	†
Total	81.3	0.4
43. FORD MOTOR CO.	81.0	0.4
44. BETHLEHEM STEEL CORP.	0.0	0.0
Bethlehem Steel Co.	79.4	0.3
Bethlehem Steel Export Corp.	*	†
Total	79.4	0.3
45. THOMPSON RAMO WOOLDRIDGE	24.3	0.1
Good-All Electric	0.2	†
Pacific Semiconductors	0.8	†
Space Technology Laboratories	51.6	0.2
Total	76.9	0.3
46. BATH IRON WORKS	73.1	0.3
47. CURTISS-WRIGHT	69.8	0.3
48. HALLICRAFTERS INC.	68.9	0.3
49. CONTINENTAL MOTORS	51.5	0.2
Continental Aviation & Engineering Corp.	16.5	0.1
Gray Marine Motor	0.2	†
Wisconsin Motor Corp.	0.2	†
Total	68.4	0.3
50. TEXTRON, INC.	6.3	†
Bell Aerospace	59.3	0.3
Textron Electronics	0.2	†
Total	65.8	0.3
51. INTERNATIONAL HARVESTER	51.5	0.2
Hough, (Frank G.) Co.	2.0	†
Macleod & Co.	*	†
Solar Aircraft	9.6	0.1
Total	63.1	0.3
52. SANDERS ASSOCS.	63.1	0.3
53. GOODYEAR TIRE & RUBBER	21.8	0.1
Goodyear Aircraft	40.8	0.2
Kelly-Springfield Tire	*	†
Total	62.6	0.3
54. FULLER (G.L.) & WEBB (D.E.) (A joint venture of George A. Fuller Co. and Del E. Webb Corp.)	62.1	0.3
55. GENERAL TELEPHONE & ELECTRONICS	2.3	†
Automatic Electric Sales.	2.2	†
General Telephone & Electronics Laboratories.	0.3	†
Lenkurt Electric	3.8	†
Sylvania Electric	52.8	0.3
Total	61.4	0.3
56. GARRETT CORP.	59.9	0.2
57. SHELL CARIBBEAN PETROLEUM	32.5	0.1
International Lubricant.	0.8	†
Shell Oil Co.	23.6	0.1
Total	56.9	0.2
58. SOCONY MOBIL OIL	48.2	0.2
Standard-Vacuum Oil§	4.7	†
Total	52.9	0.2
59. OLIN MATHIESON CHEMICAL	50.0	0.2
Liberty Powder Defense.	2.5	†
Total	52.5	0.2
60. LEAR, INC.	50.2	0.2
61. LING-TEMCO ELECTRONICS	0.3	†
Altec Lansing	0.2	†
Continental Electronics	4.8	†
F & M Electronics	0.5	†
University Loudspeakers.	0.2	†
Total	46.8	0.2
62. MORRISON-KNUDSEN	45.5	0.2
Ferguson (H. K.) Co.	0.1	†
Total	45.6	0.2
63. JOHNS HOPKINS UNIVERSITY	44.6	0.2
64. EBY (MARTIN K.) CONSTRUCTION	42.1	0.2
65. RYAN AERONAUTICAL	42.0	0.2
66. DU PONT	7.1	†
Remington Arms	34.0	0.2
Total	41.1	0.2
67. TODD SHIPYARDS	40.6	0.2
68. KAMAN AIRCRAFT	40.2	0.2
69. FAIRCHILD STRATOS	39.8	0.2
70. EASTMAN KODAK	37.7	0.2
Eastman Chemical Products	0.1	†
Eastman Kodak Stores	0.1	†
Recordak Corp.	0.4	†
Total	38.3	0.2
71. MARINE TRANSPORT LINES	37.2	0.2
72. SYSTEM DEVELOPMENT	36.7	0.2
73. MASON & HANGER-SILAS MASON	36.5	0.2
74. FLUOR CORP., LTD.	35.6	0.2
75. AEROSPACE CORP.	34.8	0.2
76. RICHFIELD OIL	33.8	0.2
American Mineral Spirits	0.5	†
Total	34.3	0.2
77. KEWANEE OIL	0.0	0.0
Mathiasens Tanker Industries	34.3	0.2
Total	34.3	0.2
78. CONTINENTAL OIL	27.0	0.2
Douglas Oil Co.	0.5	†
Malco Products	6.2	†
Westcott Oil	*	†
Total	33.7	0.2
79. MAGNAVOX CO.	32.4	0.2
80. STANDARD KOLLSMAN INDUSTRIES	0.0	0.0
Kollsman Instrument	32.0	0.1
Kollsman Motor	0.2	†
Richardson-Allen	*	†
Total	32.2	0.1
81. STANDARD OIL (INDIANA)	17.0	0.1
American Oil	14.6	†
Amoco Chemicals Corp.	*	†
Total	31.6	0.1
82. FULLER-WEBB-HARDEMAN (A joint venture of George A. Fuller Co., Del E. Webb Corp. and Paul Hardeman, Inc.)	31.1	0.1
83. NORTHERN PUMP CO.	0.0	0.0
Northern Ordnance	30.6	0.1
Total	30.6	0.1
84. KEYSTONE SHIPPING	30.6	0.1
85. LABORATORY FOR ELECTRONICS	29.7	0.1
86. INGALLS IRON WORKS	0.0	0.0
Ingalls Shipbuilding	29.6	0.1
Total	29.6	0.1
87. HAZELTINE CORP.	29.2	0.1
Hazeltine Research	0.1	†
Hazeltine Technical Development Center	0.2	†
Total	29.5	0.1
88. MIDLAND CONSTRUCTORS (A joint venture of Hardaway Contracting Co., Oman Construction Co., Inc., R. P. Farnsworth & Co. Inc., and Wright Constructing Co.)	28.9	0.1
89. WHITE MOTOR CO.	28.6	0.1
Oliver Corp.	0.1	†
Total	28.7	0.1
90. VITRO CORP.	28.4	0.1
91. FIRESTONE	28.2	0.1
92. JONES-TEER-WINKELMAN (A joint venture of J. A. Jones Construction Co., Nello L. Teer Co., and D. R. Winkelman Co.)	28.1	0.1
93. COOK ELECTRIC CO.	28.1	0.1
94. UNIVERSAL AMERICAN CORP.	0.0	†
Amron Corp.	1.5	†
Hardeman (Paul), Inc.	26.2	0.1
Norma-Hoffman Bearings	0.2	†
Total	27.9	0.1
95. WESTINGHOUSE AIR BRAKE	0.2	†
Le-Tourneau-Westinghouse	0.9	†
Melpar, Inc.	26.8	0.1
Total	27.9	0.1
96. SINCLAIR OIL	26.8	0.1
97. ARO, INC.	26.4	0.1
98. MARQUARDT CORP.	26.3	0.1
99. TEXAS INSTRUMENTS.	26.2	0.1
100. MOTOROLA, INC.	24.7	0.1
Motorola Aviation Electronics, Inc.	0.2	†
Motorola Communications & Electronics, Inc.	0.6	†
Total	25.6	0.1

* Less than $50,000. † Less than 0.05%.

‡ Stock ownership is equally divided between General Motors Corp. and Standard Oil Co. of New Jersey; half of the total military awards is shown under each of the parent companies.

§ Stock ownership is equally divided between Standard Oil Co. of New Jersey and Socony Mobil Co.; half of the total of military awards is shown under each of the parent companies.

**Stock ownership is equally divided between Standard Oil Co. of California and Texaco, Inc.; half of the total of military awards is shown under each of the parent companies.



CESSNA 1962 MODEL 310G has new design tip tanks to provide better lateral stability characteristics for the aircraft.

Price Cut on 1962 Cessna Model 310G

Improved flight characteristics through complete redesign of wingtip tanks is a major feature of Cessna's 1962 Model 310G light-twin business plane. New tip tanks are slimmer and are mounted flush to the bottom of the wings.

They are canted upward 35 deg., provide a dihedral effect that, in combination with a change of stabilizer incidence from −1 deg. 45 min, to zero, improves the airplane's lateral stability characteristics and permits holding headings or making course corrections utilizing only rudder.

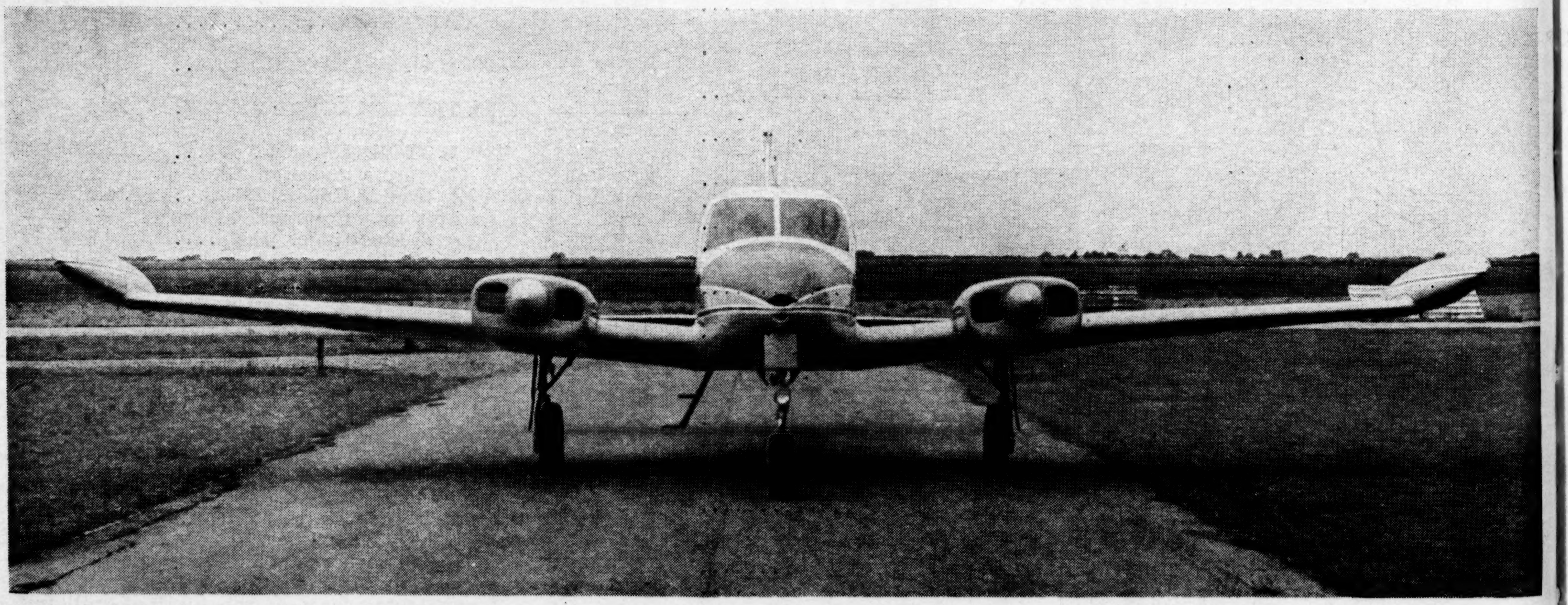
Cessna this year has instituted a significant price reduction in the basic 310G, which lists for $59,950–a cut of $2,550 from the price of last year's model 310F. Indications are that the price reduction was to establish a wider gap between this airplane and the new supercharged Model 320 Skyknight, which lists at $69,950.

The new Model 310G will be formally unveiled to the public around the country at dealer showings Feb. 3.

The airplane's new tip tanks have flush-mounted filler caps and a new drain valve and side-mounted boost pump are fitted. Tip tanks retain standard capacity of 102 gal. total of former tanks, with optional additional fuel tankage totaling 133 gal. also being available as formerly. Powerplants are the same Continental six-cylinder fuel-injection IO-470-D engines as in the 310F, rated at 260 hp. at 2,625 rpm.

The airplane's landing gear also has undergone changes to provide softer ground touchdown and ground handling characteristics. Air columns of the main gear shock struts have been altered to increase the air cushion in the compressed condition, doubling shock-absorbing capacity, the company says. Strut bearings have been modified to reduce friction and nose gear is fitted with a new tire having improved deflection and better load-carrying ability. Tire pressures on the main gear have been increased to 50 psi.

Model 310G's gross weight is 4,990 lb., compared with a maximum gross weight of 4,830 lb. for the 1961 Model 310F. With the increase in weight, useful load is up 175 lb. The new gross weight approximates that of the USAF's U-3B version of the 310. Cessna notes that the Model 310G retains all of the standard equipment provided with last



TIRE PRESSURE HAS BEEN INCREASED to 50 psi. on main gear wheels and the nose gear has a new type tire to provide better load-carrying ability and improved deflection. Landing gear has been redesigned to give softer touchdown characteristics.

NEW 310G IS REPORTED TO CRUISE at 223 mph. at 75% power at 6,500 ft. Top speed is given by Cessna as 240 mph. at sea level.

year's Model 310F and that 10 choices of complete paint schemes are again available on the new model. In addition to standard equipment the factory offers six groups of factory or dealer-installed electronic optional equipment, starting at $3,165, installed in Wichita. A Motorola L-2 autopilot is also available as factory installed equipment at $4,285, and for $930 additional an altitude hold control can be included.

Resultant Changes

Changes have resulted in some specification and performance variations from last year's model, although speed and range data provided by Cessna on the two airplanes is based on different power settings and altitudes. For example, data on last year's Model 310F is based on 70% power, similar data on the Model 310G is based on use of 75% power.

For the Model 310G, top speed at sea level is given as 240 mph., while the Model 310F was given as 242 mph. Cruise speed for the new airplane, at 6,500 ft. and 75% power is stated to be 223 mph., compared with the 310F's 220 mph. at 8,000 ft. on about 70% power.

Aircraft's Range

Range, on 100 gal., using normal lean mixture for the 310G at 75% power at 6,500 ft., is stated to be 780 mi., compared with the 310F's 825 mi. using 70% power at 8,000 ft. With 130 gal. the 310G's range at the same power and altitude (75% power and 6,500 ft.) is stated to be 1,015 mi. compared with 1,070 mi. at 70% power at 8,000 ft. for the 310F. Ranges are figured without an allowance for fuel reserve.

Rate of climb on two engines is given at 1,750 fpm. for the Model 310G compared with 1,800 fpm. for the 160-lb. lighter Model 310F.

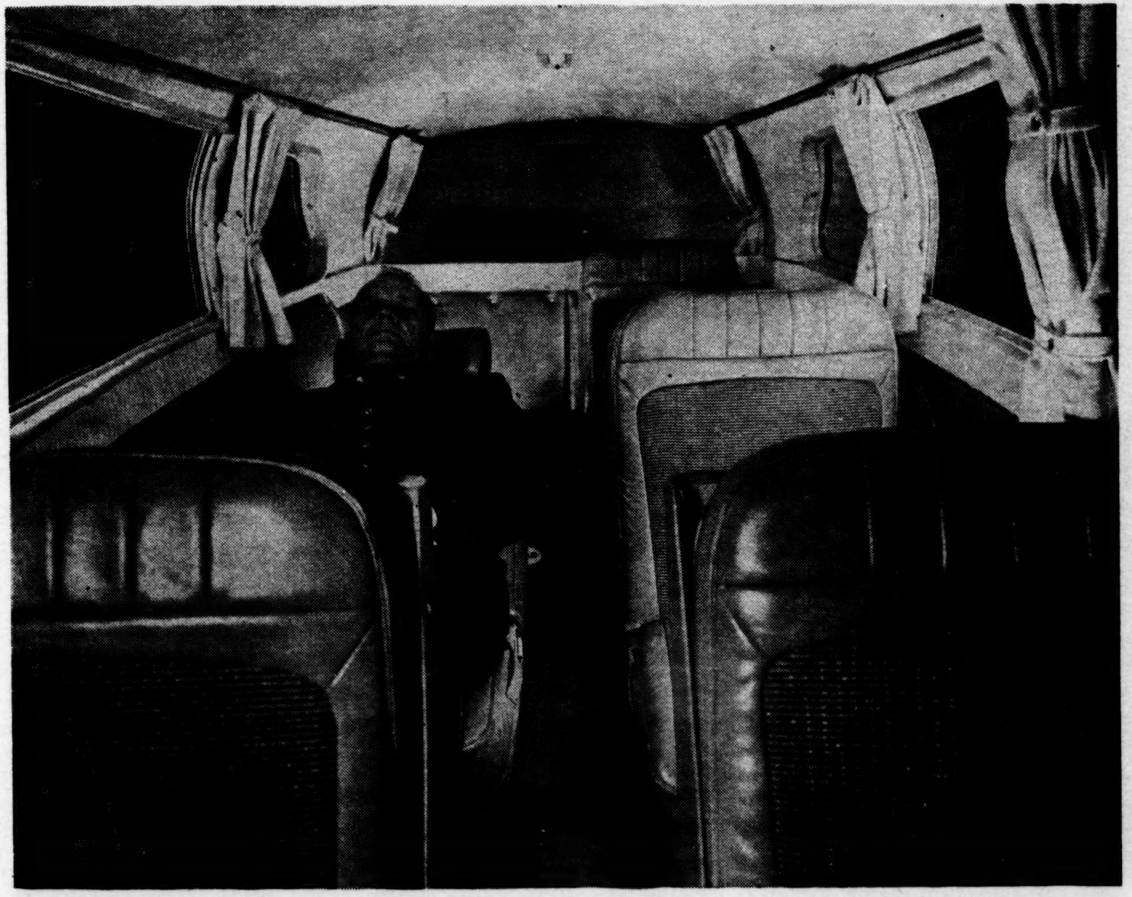
Single-engine climb rate for the two airplanes is 400 fpm. and 440 fpm., respectively.

Takeoff ground run for the Model 310G over a 50-ft. obstacle is 1,470 ft., 75 ft. more than the 310F requires and landing distance over a similar obstacle is 1,770 ft., an increase of 50 ft. over the Model 310F. The new airplane has slight increases in wing and power loadings due to weight increase. Wing loading now is 28.5 psf. and power loading is 9.6 lb./hp.

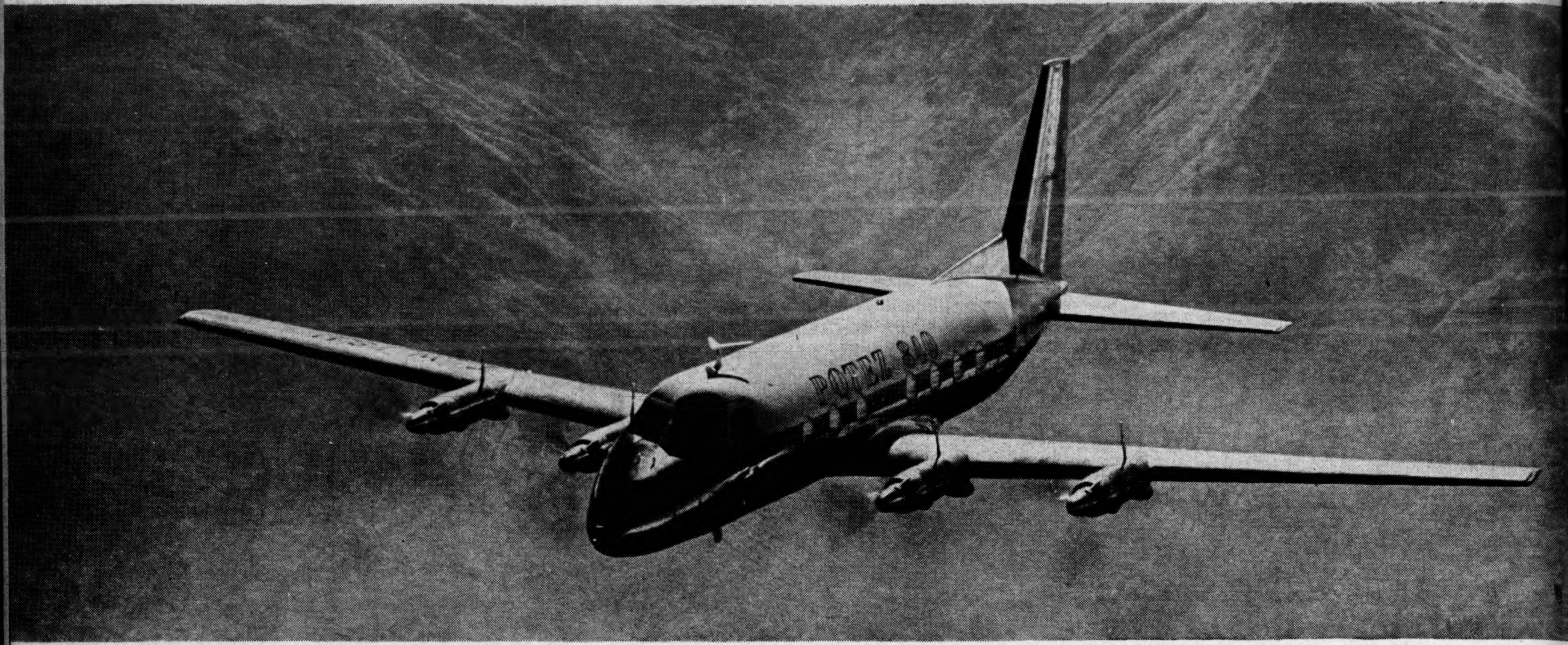
Dimensions of the two models remain essentially the same, except that the new canted-out tip tanks on the Model 310G increase wing span from 36 ft. to 36 ft. 11 in.

Standard seating comprises two front individual seats and a three-place rear seat.

Optional, in addition to two front seats, are two rear individual reclining seats for $388 extra, two adjustable rear seats at $701 extra, a five-seat configuration with three rear individual seats at $941 extra, and a five-place version with a single adjustable rear seat and a two-place lounge for $662 extra.



FIVE-PLACE CABIN ARRANGEMENT provides each occupant with an individual seat. Four front seats have folding cantilever armrests either as standard or optional equipment.



POTEZ 840 turboprop transport's nose section is drooped for good visibility. This is No. 1 prototype.

Aviation Week Pilot Report:

Potez 840 Has Automatic Throttling

By Herbert J. Coleman

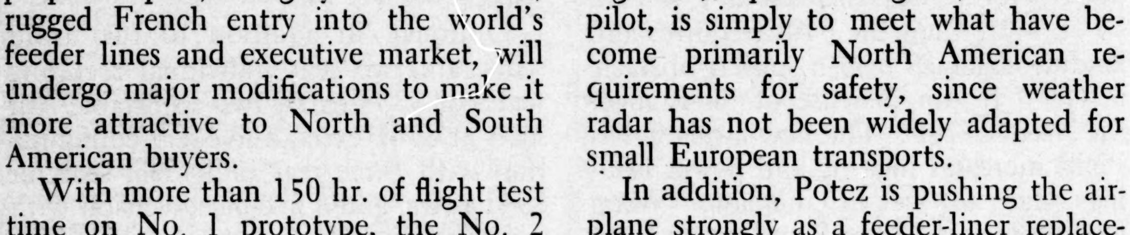
Paris—Potez 840 four-engine turboprop transport, a highly maneuverable, rugged French entry into the world's feeder lines and executive market, will undergo major modifications to make it more attractive to North and South American buyers.

With more than 150 hr. of flight test time on No. 1 prototype, the No. 2 airplane, now more than half completed, is being fitted with an entirely new nose section designed to take a Collins weather radar. In addition, cockpit visibility, already good, is being improved by extending side windows further rearward.

Prime reason for the changes, according to Jacques Grangette, chief test pilot, is simply to meet what have become primarily North American requirements for safety, since weather radar has not been widely adapted for small European transports.

In addition, Potez is pushing the airplane strongly as a feeder-liner replacement. Weather radar is a necessity for this use, and the added cockpit visibility will appeal to pilots.

No. 2 Potez 840 will be flown to the U. S. next year, where the sales agent, Turbo Flight, Inc., of Chicago, will start demonstration tours. Airplane will be sold to Turbo Flight, which is negotiating orders for 24 more airplanes. Price, including the modifications, is planned to be about $500,000 duty paid in the U. S. (AW May 29, p. 71).



MOCKUP of Potez 840 shows high-density seating configuration for feederliner operation. Seats are slightly canted for better leg room; aircraft would have 24-passenger capacity.

At present, production is geared to four Potez 840s—the No. 1 prototype now flying, No. 2 modified for U.S. consumption, a third demonstrator to build up time and a fourth for static testing to destruction, according to Pierre Canneill, chief of flight test.

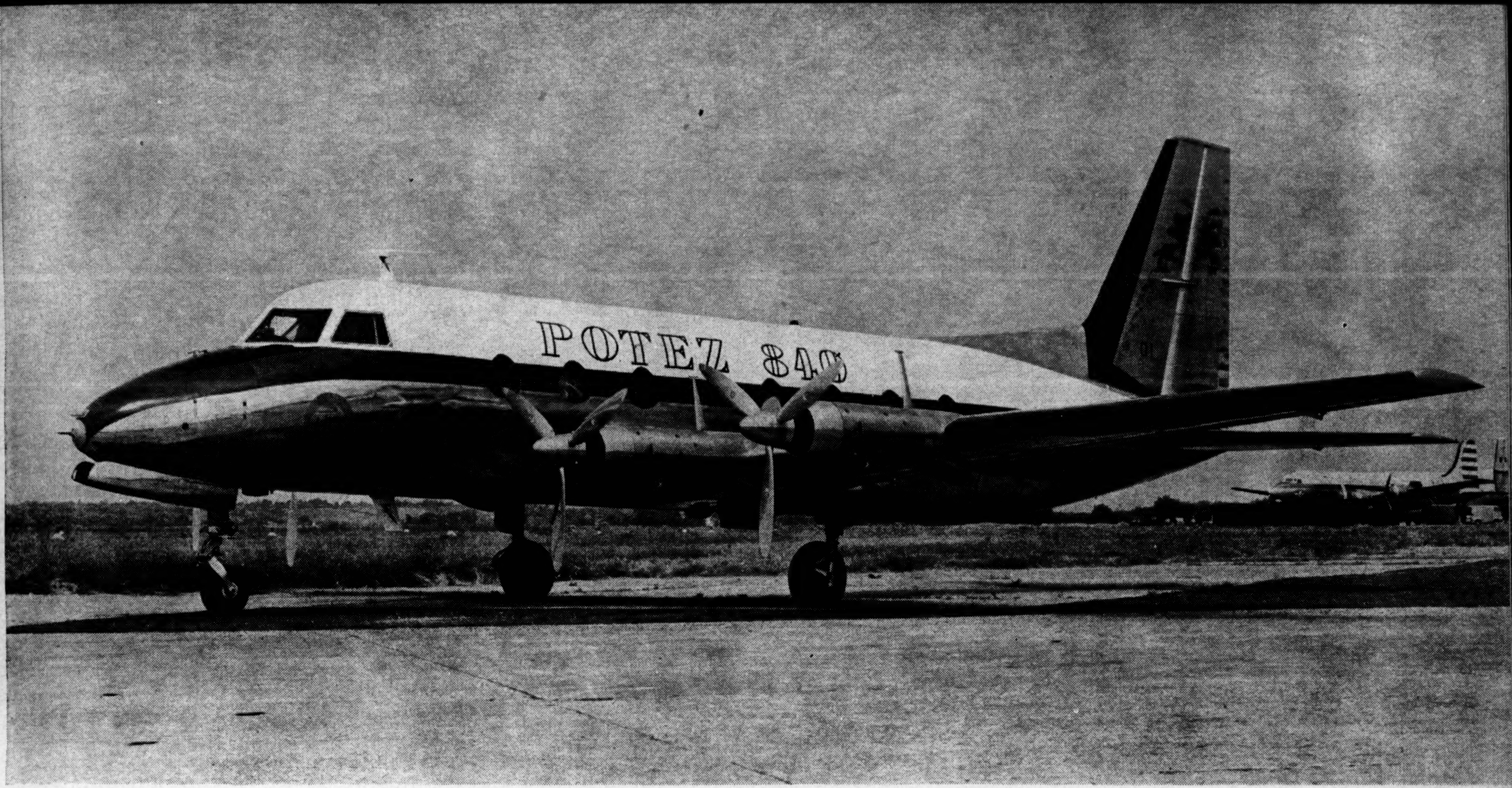
With the exception of one landing accident that put the plane out of commission for about a month, the test program has been highly successful, and the designers have made no major modifications in the initial airframe or engine, aside from the usual instrumentation juggling.

Production Plans

The company still plans to set up an 840 production line near Galway, Ireland, where Potez has non-aviation interests, despite a marked lack of enthusiasm from the French government.

The main reason for the move is to keep the price at its $500,000 level, according to Gerard Potez, company general secretary and son of founder Henry Potez. The turboprop plane has been entirely funded by Potez, since government aid has been aimed at the Max Holste Super Broussard.

Gerard Potez said production facilities could be quickly attained, and labor requirements filled by Eire residents and key personnel from the British aviation



VERTICAL PROBES on each engine nacelle were installed to collect whirl mode data from propeller airflow.

industry who would be attracted to the move. Most could be in-house trained with little problems, he added.

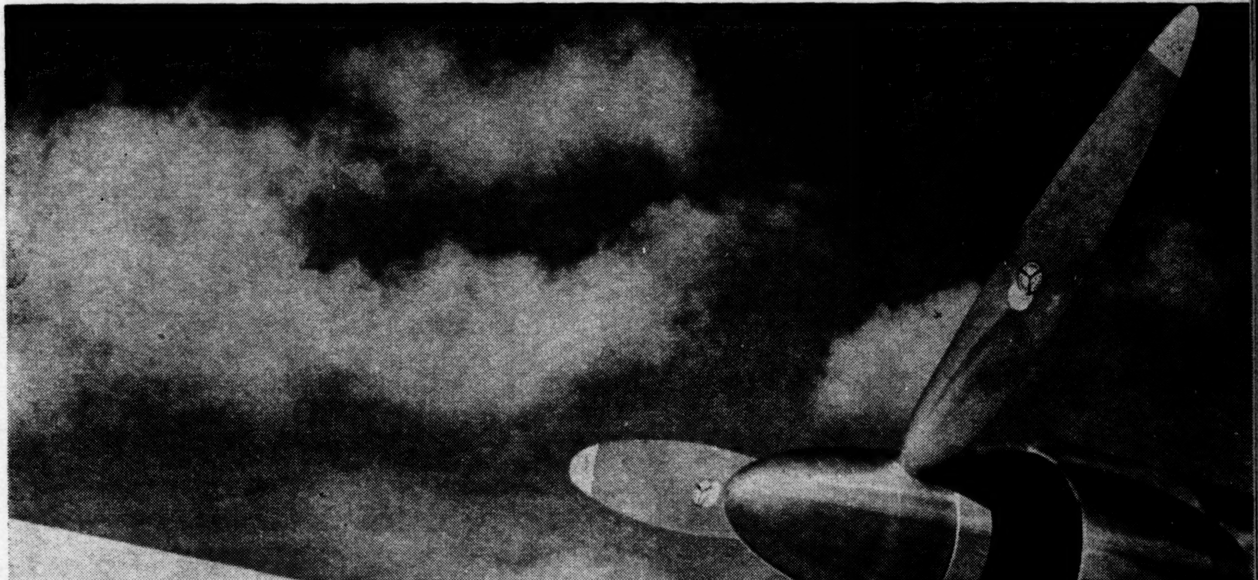
If enough orders are forthcoming—and Potez officials are enthusiastic about the world-wide potential for what they believe is essentially an aircraft without a competitor—a line also could be established at Argenteuil, where the Potez-Fouga Magister jet is in production.

Comparatively low cost has been an important design requirement, although the modifications for North and South American sales can be expected to cause some price rise. Potez feels the market is limited only by the airplane's utilization, and hence is pushing it hard as a feederliner replacement, along with its obvious attractions as an executive transport.

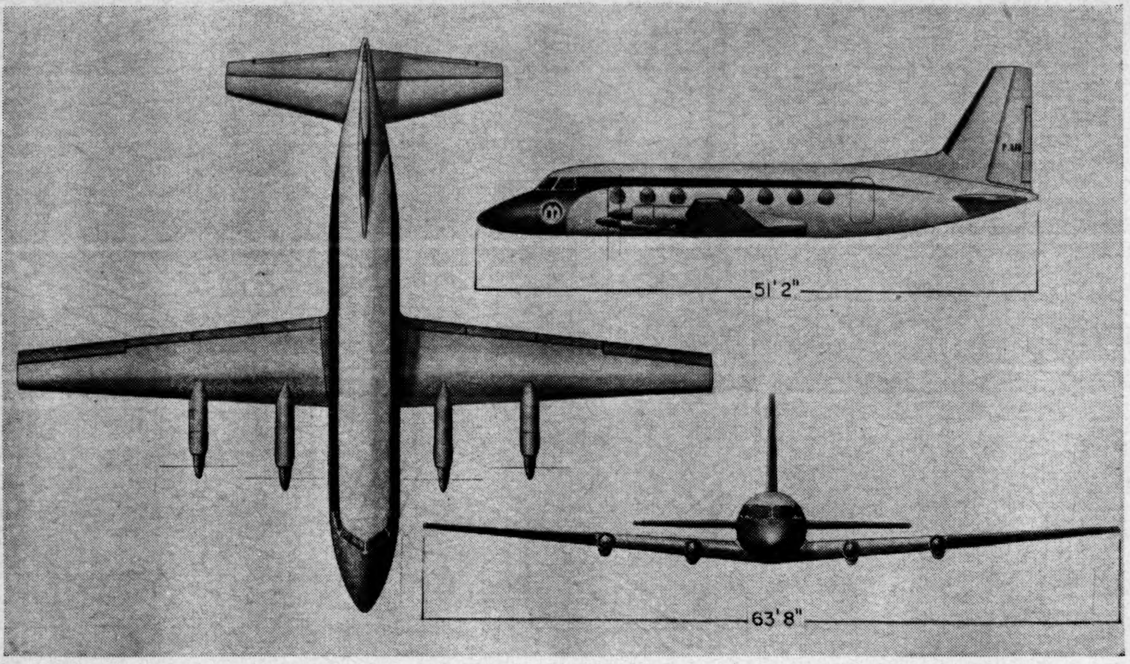
Thus the company's mockup is fitted out with 24 back-to-bulkhead seats, slightly canted rearward, in which the passengers would face each other across the center aisle. Another version proposed is for 16 seats, forward facing, for first-class fares only.

One important sales area is as a military transport and/or trainer, and a number of high-ranking NATO officers have flown the airplane for evaluation of this role. For that matter, Potez flies its test program out of Villacoublay Airport, home base of GLAM, the French Air Force VIP transport center, and thus key personnel of the world's air forces get a first-hand look at the 840.

Airplane F-WJSH was flown by this Aviation Week pilot from Villacoublay, with Chief Pilot Grangette. Also aboard were Canneill, two Potez test technicians to record data, and two West Germans, Claus Kühl, managing director of Deutsche Taxiflug GmbH,



POWERPLANTS for the Potez 840 are four Turbomeca Astazou turboprop engines rated at 522 shp. Main landing gear retracts into wing. Wing skin is an aluminum alloy called Vedal A.5 which is .078 in. thick at wing root and tapers to .039 in. at tips.



HEIGHT of the Potez 840 is 17.8 ft. Wing area is 377 sq. ft. Aspect ratio of the wing is 10.75. Main gear retracts sideways into the wing; nosegear retracts forward.

and his chief pilot, Rolf Stumpp, a former C-46 pilot.

Weather was poor and had gone to absolute minimums of 300 ft. and 1 mi., with further deterioration forecast. Thus, ground instruction was kept to a minimum to beat the lowering ceiling.

The walkaround inspection is basic, a visual check of the airframe, control surfaces, engine and fuel tank fastenings and propellers, and the Messier landing gear. Inside configuration on the prototype changes constantly, depending on current instrumentation needs for test equipment. During this flight, eight seats were fitted in the aft fuselage, with test equipment forward.

The fuselage is cylindrical and seats are mounted facing forward on steps at either bulkhead, to allow a low aisle and headroom which is just adequate for a six foot man. Main wing spar runs spanwise through the cabin, resulting in a floor barrier of about 1 ft. high in the center fuselage. The cabin and cockpit are well appointed and soundproofed and a single toilet is installed at the extreme aft section, near the baggage compartment.

The cockpit is small but sufficiently roomy for a tall pilot. First impression is of compactness, and functional display of instruments and controls, which are blocked for the varied uses. Control wheel is U-type mounted a bit higher than is normally seen on similar planes; wheel is about opposite pilot's chest.

A striking feature is high concentration of automatic equipment—the Potez 840 is a pushbutton airplane in the full sense, including a button which gives automatic throttling, and a Lean LIFE flight director system for auto lock-on to VOR radials and ILS systems.

Starting Procedure

Engine start sequence is automatic, with warning lights to guard against false or hot starts. Control buttons are located on center roof section. Start sequence takes over, using in this flight the airplane's batteries, when pitch control lever was set to "zero pitch" and throttle moved to start position manually. At this position, barely cracked, the throttle operates a fuel flow control for minimum amount needed to start the engine.

Power of the four Astazous is determined at a constant speed by the propeller pitch, and the pitch lever is the engine control used by the pilot to gain variations in power and speed. For instance, in a dive, throttles will automatically retract to guard against overspeed, and will advance when the 840 is put into a climb angle.

Pitch Limiting Device

To guard against engine overspeeding beyond its limits, Potez has installed a pitch limiting device in the system. Astazou turbine includes two compressors—one axial and the other centrifugal—annular combustion chamber with direct fuel injection, three-stage axial flow turbine and exhaust diffuser. Maximum power load gives unit speed of 43,500 rpm. The four engines develop a total of 2,092 hp. on takeoff. The engines are interchangeable.

Checklist includes setting of the horizontal tail by an electrical trim control on the main pedestal, using a predetermined center of gravity position. The control instrument is divided into percentages; if 16 persons were aboard, tail would be set at 28%. Aileron and rudder trim controls are electrically-actuated by wheels on the pedestal, and the elevator control is an electrical tab on the control wheel, which also includes a Lear autopilot cutoff by flicking to full down.

With No. 1 engine turning over, power is switched from the aircraft cadmium nickel batteries to one of four generators; two inverters are carried, one in the nose and the other aft of th pilot, and circuit breakers are mounte on roof over the pilot.

While watching start lights, pilo also immediately checks the temperature for a maximum of 450 deg. and rpm. gages for proper rises. The starte then cuts out at 42% rpm. Pitch control is set to 100% propeller pitch where it usually remains for the res of the flight, except for the usual adjustments to prevailing conditions.

Droop nose section makes forwar visibility excellent for taxiing and turn are easily controlled by light taps o rudder brake pedals. Villacoublay control cleared us to Runway 27 where we held for final takeoff clearance.

Initial approval was to take off, climb to 2,500 ft. and hold a heading of 27 deg. until further notice. Brakes were held as throttles ran to 100% power then released for takeoff. The nose was rotated at about 80 kt. and climbout was at 95 kt., giving a climb angle o about 30 deg., to reach the 2,500 ft altitude as soon as possible. On this takeoff, it took about one minute; takeoff roll took about 1,500 ft.

The flight finally was cleared by Orl control to a southeast quadrant, and climb to 11,000 ft., breaking into the clear at about 10,000 ft., still using the 100% power settings. Cabin pressure, controlled by a switch on the co pilot's side, is maintained to the equivalent of 4,500 ft.; air conditioning i bled from No. 1 and 2 engines.

At cruise power, noise level in th cockpit is not high, although in th case of this flight, the intercom-headse system was used because of the stead patter of conversation. In-flight visibility is excellent, but limited rearward a situation which will be fixed on th No. 2 aircraft.

The Potez 840 has definite fighter-lik handling qualities, delicate but no overly sensitive. The airplane is eas to handle in steep turns, up to 40 deg on this flight, and the rollout can b accomplished to level flight without th usual flubbing across the horizonta plane found when recovering from suc unusual attitudes. It's an aileron ai plane; the vertical rudder is large and at 840 speeds, is hardly used unless th pilot wishes to tighten a turn.

At level flight, the 840 trimmed ou quickly to a 220 kt. indicated cruis speed. Airplane is not fitted with a outside air temperature gage, which i included in aft-end electronic test gear, but ground speed worked out to better than 300 mph.

Emergency Procedures

Because of the weather difficultie and considering the 840 is a fairly ne airplane, emergency procedure testing was kept to a minimum. However Grangette feathered No. 1 and 2 en gines, by simply retarding the two propeller controls and cutting the fuel.

The effect on controls was negligible. Immediate reaction was a drop in speed to about 170 kt. indicated and wing was picked up with only slight aileron trim. The 840 was put into about a 30 deg. bank into the good engines, with no trouble, and rolled out easily. Control was almost as good in a sharp turn, about 20-25 deg. into the dead engines, and despite the expected sluggishness on recovery, the airplane returned to level flight rapidly.

By this time, about 1 hr. 40 min. after takeoff, Villacoublay weather was below minimums and Grangette was given the option of Orly Airport or Bretigny Air Force Test Center for a GCA-ILS landing. He chose the latter because of available hangar space.

Until the final approach, much of the preparatory work was automatic, using the push-button throttling control and the Lear LIFE system to lock onto Bretigny VOR. Weather was about 400 ft. ceiling and 1 mi. visibility; final approach was flown at about 100 kt. and touchdown was about 80 kt., using 45 deg. flap. Propellers were reversed by moving throttles to full rear detent position, for short field landing roll of some 1,800 ft.

Cabin Configuration

The Potez 840 cabin is cylindrical, 35 ft. long, with 14 windows, seven on either side. Baggage hold has a volume of 85 cu. ft. Wing is straight tapered type, having an aspect ratio of 10.75 and of fail-safe monospar construction. Double-slotted flaps are electrically controlled. Wing to fuselage assembly is at four points; skin tapers from 5/64th in. to 1/32nd in. and is stiffened by ribs. Integral fuel tanks hold 406 U. S. gal.

Fuel system of each engine is independent of the other three, although a crossfeed allows any two systems to be joined. Each system includes two integral fuel tanks, one equipped with purge valve which drains by gravity into the second tank. Both are vented by a plunger to provide space for expansion, and a ball valve prevents fuel surge.

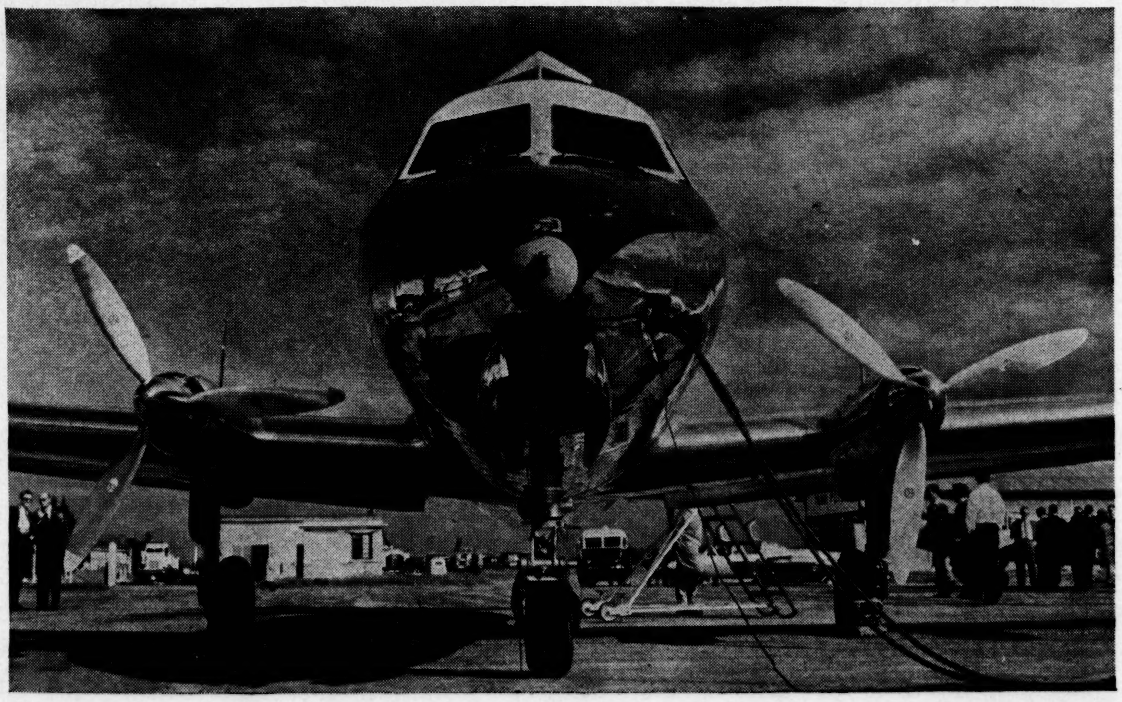
Wing and tail units are equipped with de-icer boots, bonded to the leading edges, and inflated by a cycled pulsation. Pilot's windshield is heated by electricity and accumulated rain is swept away by hot air blast.

Hydraulic System

Hydraulic system includes two self-regulating pumps, driven by No. 1 and 2 engines, to provide 3,000 lb./sq. in. pressure. Cutoff valve isolates each pump in case of fire, and a hand pump, located at pilot's right, is available for emergency lowering of the tricycle landing gear. Braking is normally accomplished by depressing the rudder pedal tips, although an emergency brake is incorporated in the parking brake.

Electrical system centers on four starter generators, each producing 2,200 watt per unit, and driven by the turboprops. Battery supplies 28 v.d.c. current. Radio equipment on the prototype is a Collins package, including a VHF transceiver, plus an emergency VHF, a radio compass which can operate on pre-selected channels, VOR indicator with marker beacon, and a radio altimeter operating to 2,000 ft. above the ground. The Lear LIFE system comprises a flight director, gyro horizon, compass and localizer, integrated with the Lear autopilot to allow setting up an automatic holding pattern.

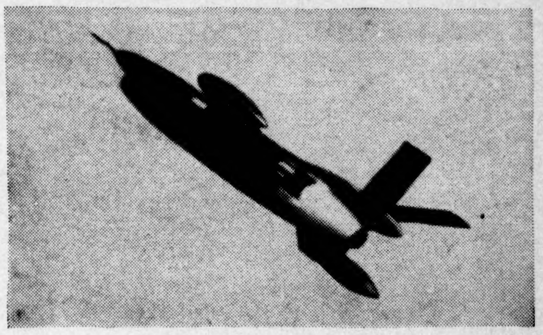
Potez currently is refining its after-sales organization, based on a successful operation set up for the Magister, in which the company will study the customer's needs, organize training courses and distribute technical information.



FORWARD visibility during taxiing is good, due to Potez 840's drooped nose. Engines are started electrically from external source or from aircraft's batteries.

NORD-AVIATION
Ordnance
Research
Development

CT-20 TARGET DRONE
SIX RECOVERABLE FLIGHTS



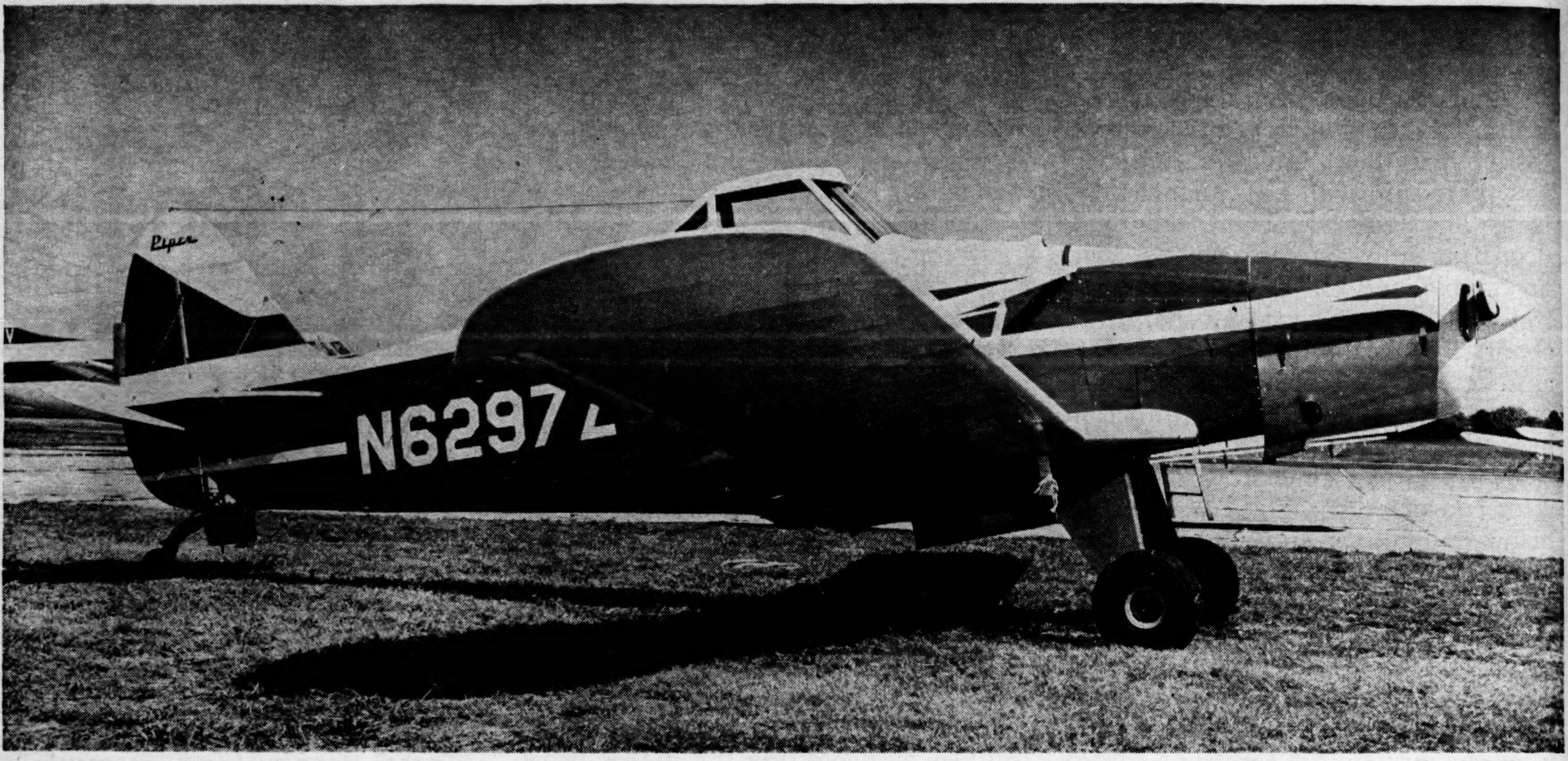
Nord's CT-20 is zero length launched and radio controlled. These drones have averaged six flights, recoverable in the sea as well as on land. Simplicity of design and operation, plus maximum re-use, represent cost savings.

MAIN CHARACTERISTICS

Speed at 32,800 ft.	560 m.p.h.
Time to 32,000 ft.	6 min.
Mean endurance	45 min.
Service ceilling	40,000 ft.
Take-off weight	1,470 lbs.
Span	11.15 ft.
Length	17.71 ft.
Diameter of fuselage	2.16 ft.
Wing area	34.34 sq. ft.

NORD-AVIATION

2-18, rue Béranger
CHATILLON-SOUS-BAGNEUX
(Seine) France



PAWNEE 235-HP. agricultural light plane retains 150-hp. model's basic structure except for some strengthening to handle 600-lb. increase in gross weight. Prototype shown is fitted with experimental engine cowling being tested to study cooling effects.

Uprated Pawnee to Supplement Older Type

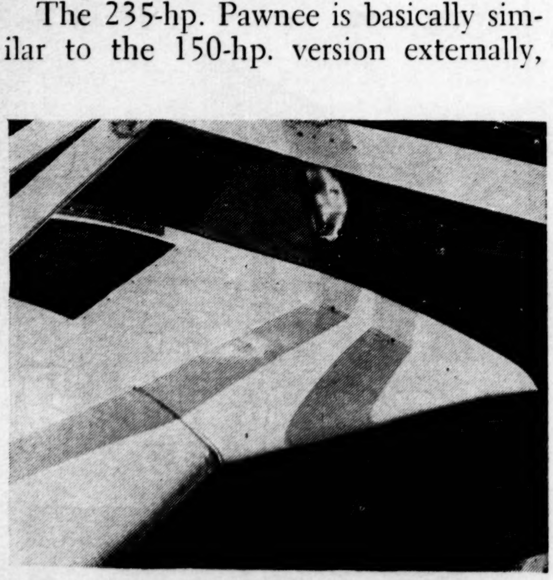
By Erwin J. Bulban

Vero Beach, Fla.—Broader penetration of the agricultural airplane market is the aim of a new model of the Piper PA-25 Pawnee featuring increased horsepower and gross weight over the earlier version.

The new PA-25-235, which will be available later this year, will supplement rather than replace the current 150-hp. Pawnee, providing additional payload and altitude performance for those operators who need these characteristics.

With development of the 235-hp. model, the company's research and development center here has engineered numerous improvements on the 150-hp. airplane, which are incorporated in the more powerful version.

The 235-hp. Pawnee is basically similar to the 150-hp. version externally, the prime difference being in strengthening the structure to take the additional power and the higher gross weight, which is 2,900 lb. compared with the lower-powered airplane's 2,300 lb. The same 20-cu.-ft. spray/dust chemical hopper is installed in both aircraft, but the higher-power engine permits filling it to the limit of its 1,200-lb. capacity, whereas the legal limit with 150-hp. is 800 lb.



FORWARD SKEWED leading edges, aimed at reducing tail buffeting near the stall, will be available in kit form, as optional equipment in the Pawnee.

Powerplant on the new version is the six-cylinder Lycoming O-540-B, similar to the engine used in the 250-hp. Comanche four-place business plane, but fitted with lower-compression pistons to permit use of more readily available and lower cost 80 octane fuel.

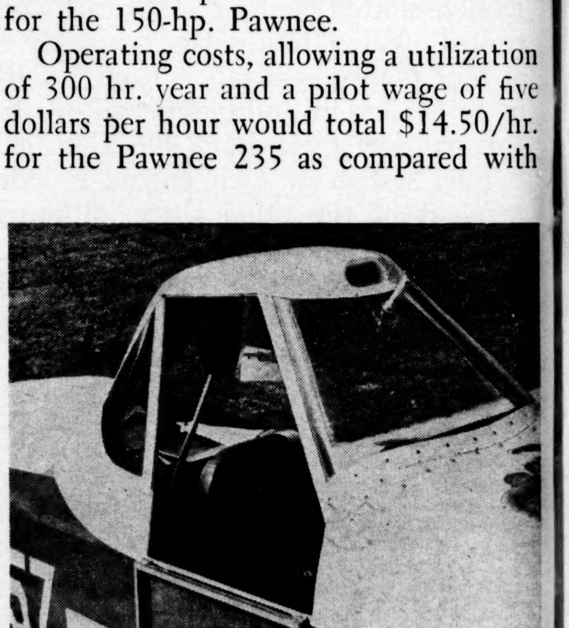
With this engine, the Pawnee 235 is about 15 mph. faster than the 150-hp. model and ground run is approximately 100 ft. longer due to higher wing loading at gross weight. But the climb speed is approximately 630 fpm., or about 25% more than the lighter-powered airplane. It will clear a 50-ft. obstacle in approximately the same distance—about 1,375 ft.

Comparative Testing

To provide some measure of the two airplanes' comparative performance on a typical spray chemical application mission, a requirement of 3 gal./acre on a field having swath runs of one-third-mile long and with 40-ft. swath spacings was computed by Piper engineers. Ferry distance of three miles from the field to be sprayed and the landing strip where chemical loading is handled is included.

Average operating speed of the 235-hp. Pawnee would be 98 mph. compared with the 150-hp. version's 85 mph. Including a loading time of five minutes for 1,200 gal. on the new airplane compared with four minutes for the 150-hp. model, and considering 30-deg. banked turns during application, the higher-powered airplane could accomplish the mission at the rate of 76 acres/hr. compared with 69 acres/hr. for the 150-hp. Pawnee.

Operating costs, allowing a utilization of 300 hr. year and a pilot wage of five dollars per hour would total $14.50/hr. for the Pawnee 235 as compared with



AIR INLET in canopy top above windshield provides improved, controlled cockpit ventilation; replaces former inlet mounted on side of cockpit.

$11.70/hr. for the Pawnee 150, with cost per acre figured at 35¢/hr. for the former type and 32¢/hr. for the latter. Data does not consider costs of ground equipment, labor for loading airplanes and ferrying them to job.

Design Changes

Among the basic improvements in the Pawnee design are strengthening of the airplane's rear fuselage structure, including tail post and longerons, to handle loads imposed when the tail is severely swung around while the airplane is maneuvered on rough ground. The steel wing lift struts are now zinc metallized prior to painting to resist corrosion. The handle for locking the shoulder harness inertia reel has been relocated from the floor to a position on the seat frame where it is easier to reach and is more rigidly attached.

Main wing hinge fittings have been changed from forced aluminum alloy to forged steel alloy having greater bearing strength—Piper notes that there has been some evidence of hole elongation in some of the aluminum alloy fittings after hard service and the company recommends that these be replaced by the newer type.

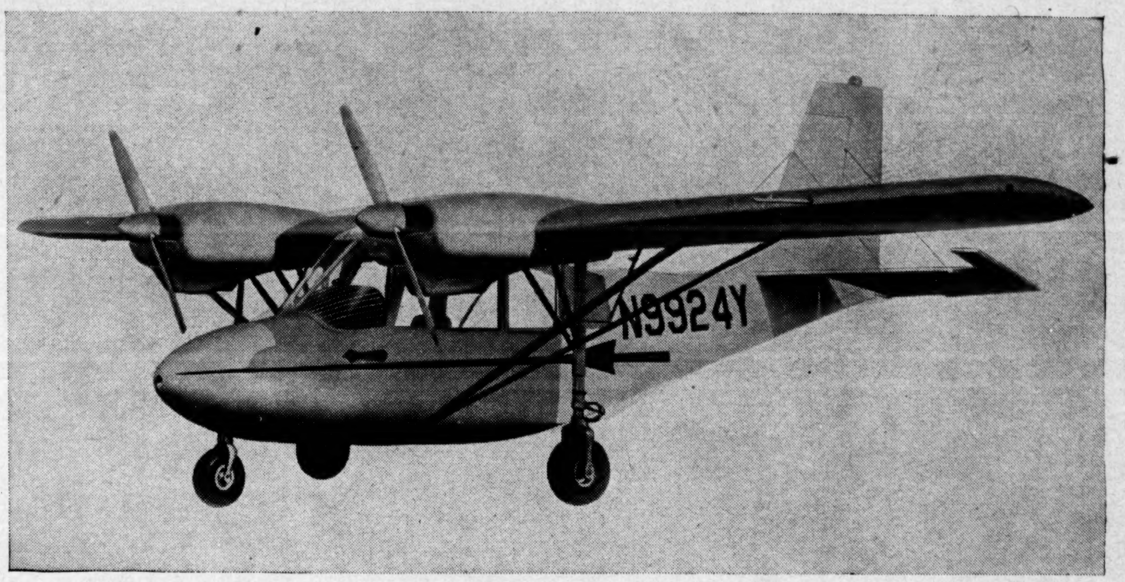
Spray Equipment

Spray equipment improvements include moving the plumbing outside the structure to provide easier checking of its condition and maintenance, changing from brass nozzles to nylon type which are lighter and more corrosion resistant and mounting spray pumps with a quick-release bracket for easier change from spray to dust missions. Quick-change toggle clamps are also used on the dust spreader for the same purpose.

The Pawnee hopper agitator mechanism, which stirs up the dust for smoother flow, was designed for a liquid-proof bearing where it penetrated the dual-purpose hopper. This bearing was affected by corrosion and has been replaced by a gland nut with Teflon packing which serves both as a bearing and seal and which has improved life. Control mechanism for the hopper gate has been redesigned to make it simpler to set the desired gate opening and provide the pilot with an exact indication of the amount of opening. Curved outer vanes in the hopper which provide wide swath pattern now are of thicker and harder material to better resist abrasive affect of dusting materials.

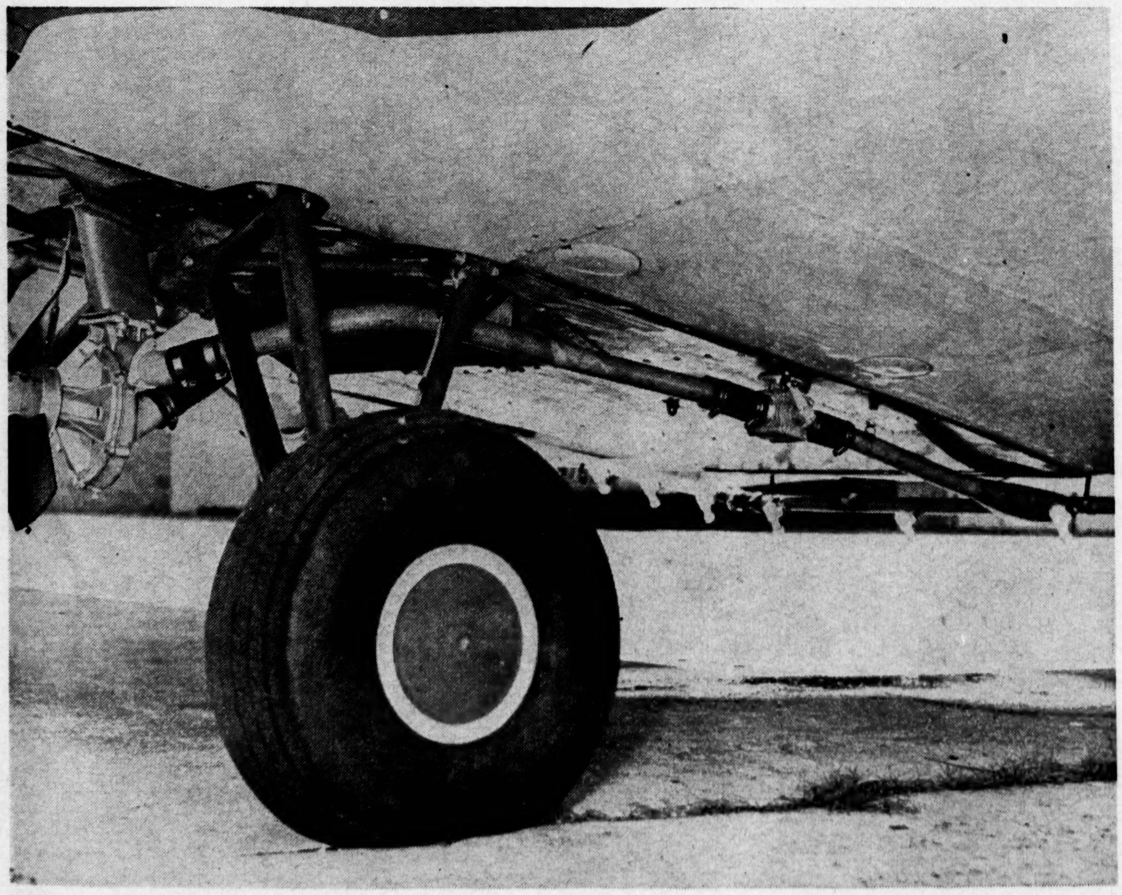
Cockpit ventilation is improved by a ram-air type inlet in the top of the canopy above the windshield, providing not only considerably greater air flow but better control of amount and direction of flow through the cockpit. Engine exhaust pipe emerges from the right side of the cowling just above wing level where exhaust flow will not interfere with dust dispersal.

Piper also has developed, as optional, a spray loading system having a filler neck located on the side of the fuselage behind the wing trailing edge to obviate need for loaders to climb on the airplane's wing with hose to load the hopper-tank in front of the cockpit, thus preventing possibility that highly toxic and corrosive chemicals could drip over the structure or run along the fuselage into the cockpit. Higher output system is also available, capable of dispensing up to 15 gal./acre with a 40-ft. swath.



Champion to Market Lancer Twin in 1962

Champion Aircraft's new light twin, the Lancer, is expected to be certificated in early 1962. The aircraft is powered by two Continental 0-200 engines rated at 100 hp. at 2,750 rpm. Two persons are seated in tandem configuration. The Lancer will have a top speed of 123 mph. and will cruise at 115 mph.

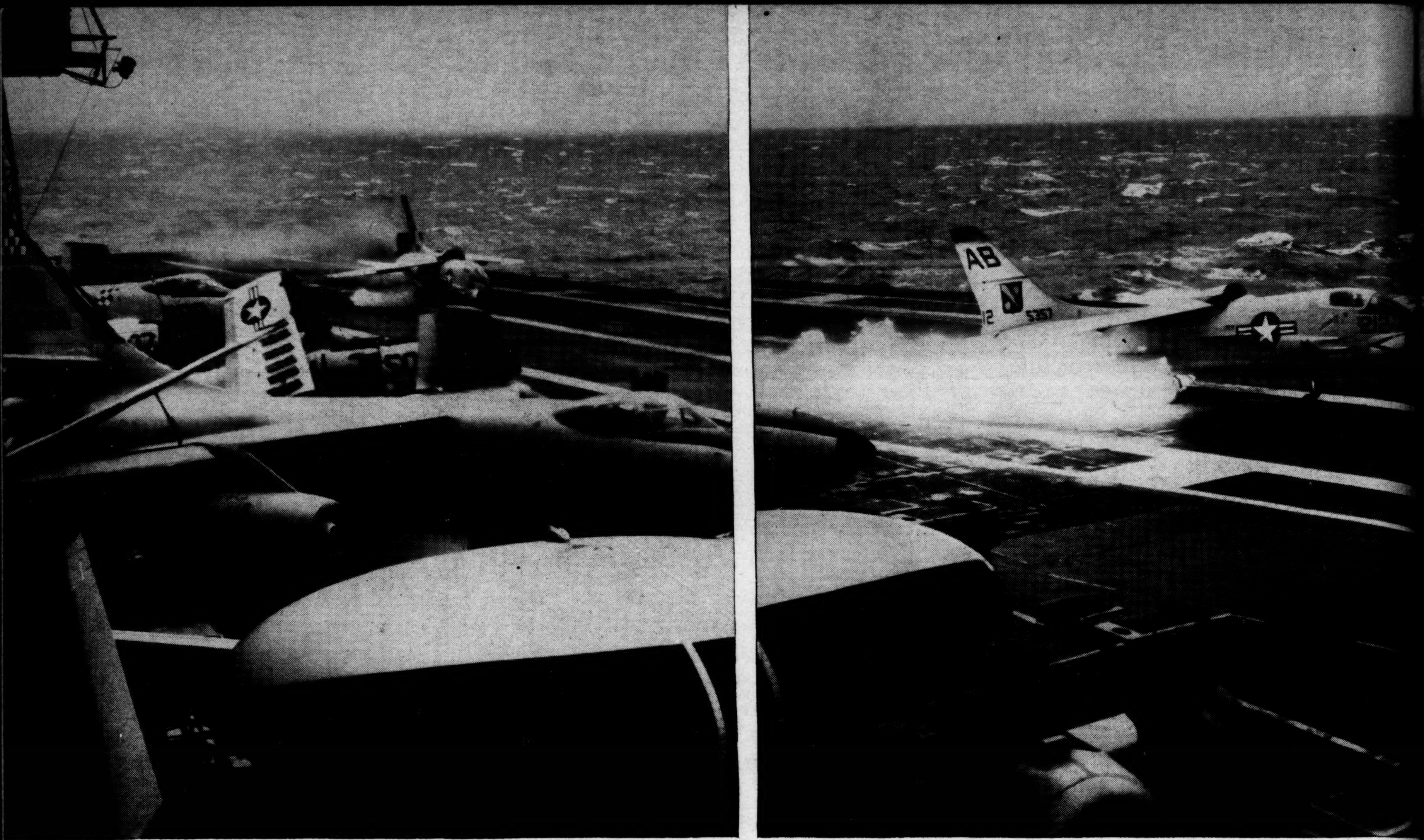


SPRAY SYSTEM LINES are mounted externally on new Pawnee to simplify checking and maintenance. Spray pump and booms are of quick-detach type permitting conversion to dusting operation in 15 min.

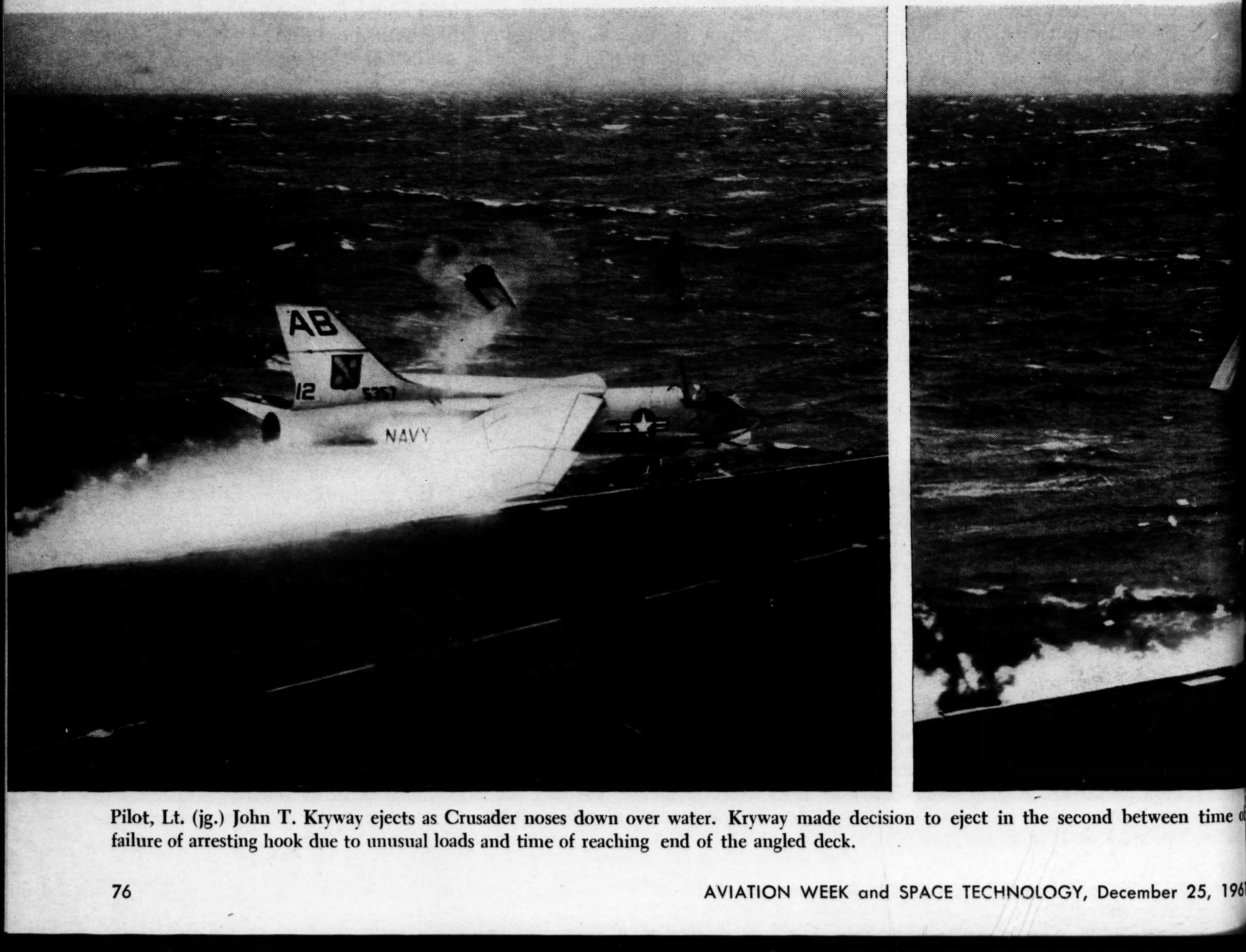
PRIVATE LINES

Aero Commander, Inc., has created a factory service center in Bethany, Okla., to handle all factory modifications, modernization and repair on Aero Commanders. This work formerly was performed by putting the aircraft to be modified back on the production line. Roy Gardner, former supervisor of field service for the company, has been named manager of the center.

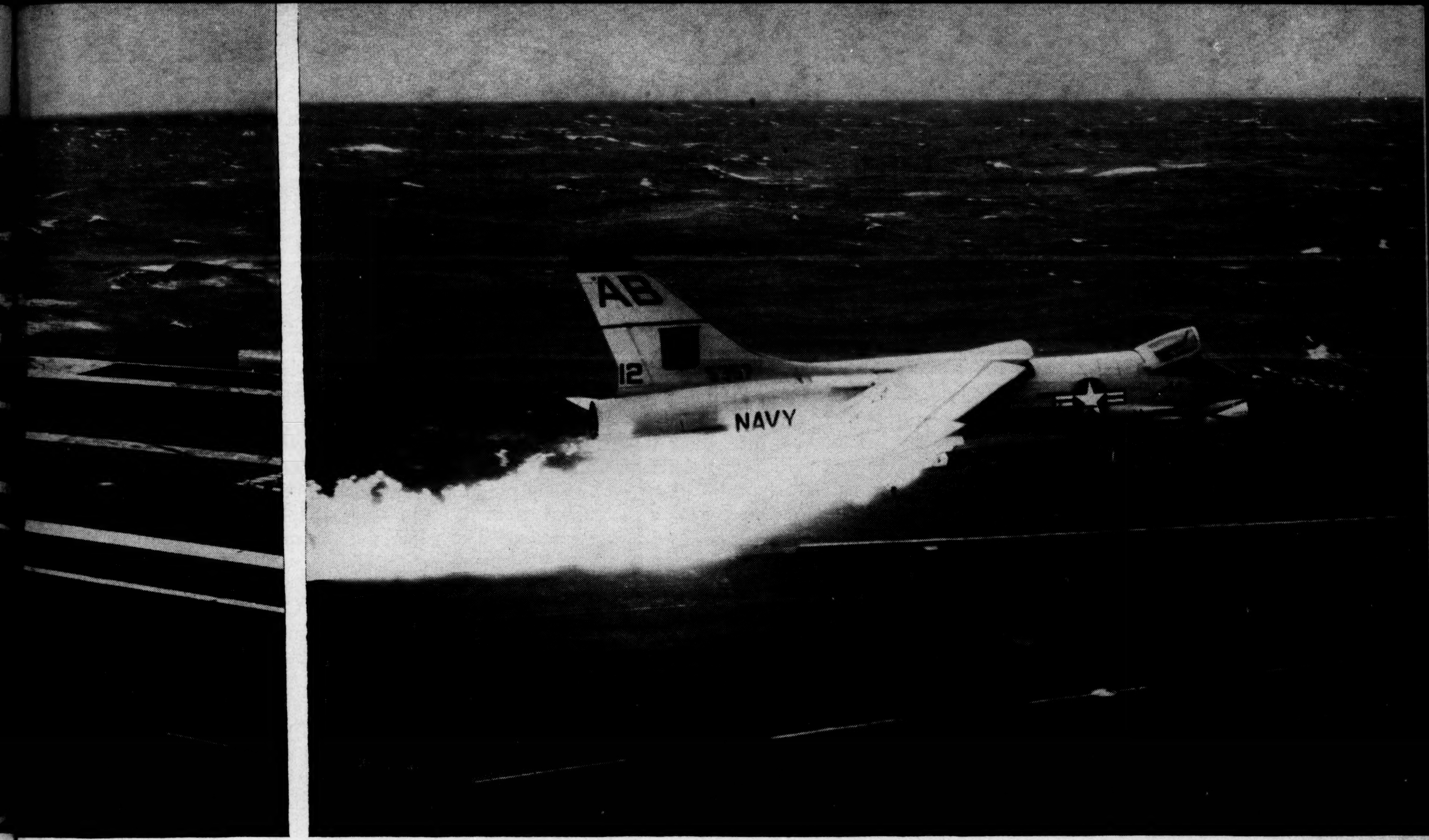
PD-808, utility turbojet transport to be produced jointly by the Douglas Aircraft Co. and Piaggio and Co. in Italy, has been named the Vespa-Jet. Vespa, meaning wasp in Italian, is the name of a line of motor scooters produced by Piaggio.



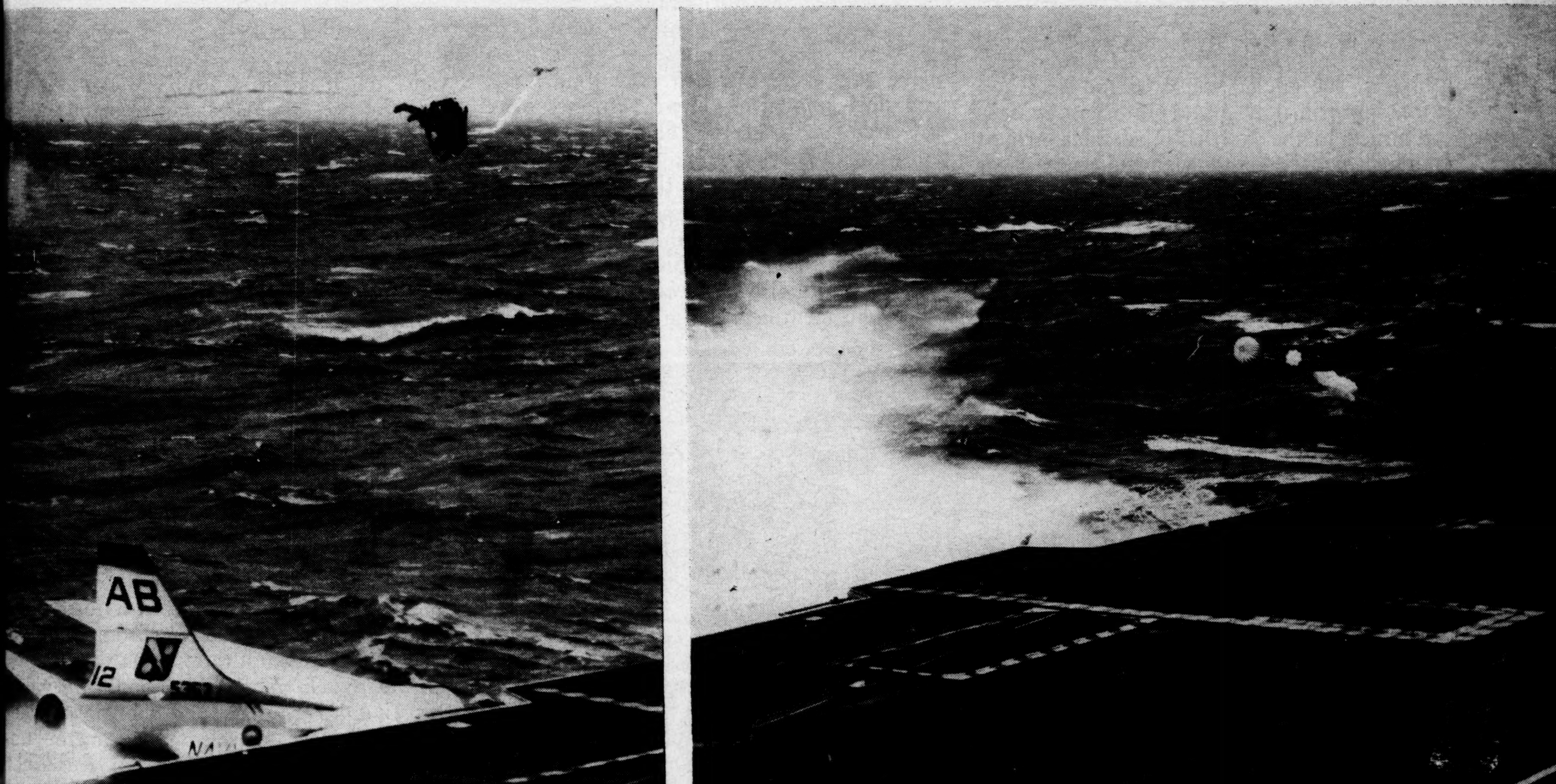
Sequence Photos Show F8U Crash, Pilot's Escape



Pilot, Lt. (jg.) John T. Kryway ejects as Crusader noses down over water. Kryway made decision to eject in the second between time failure of arresting hook due to unusual loads and time of reaching end of the angled deck.



Navy/Chance Vought F8U Crusader fighter loses right main gear during hard landing on aircraft carrier Franklin D. Roosevelt. Unusual ship motion, which caused upward deck pitch at moment of the crash, was blamed. In center photo, magnesium landing gear strut ignites due to friction on the deck. Over the deck speed was 96 to 98 kt. Momentary engagement of an arresting cable and drag of landing gear strut slowed aircraft to an estimated 60 kt. (actually, 67 kt. due to loss of wind as the aircraft emerged off deck over water). Ejection sequence begins in third picture with jettison of canopy.



Pilot chute begins to deploy as aircraft disappears. Ejection seat is a standard Martin-Baker zero level type. In the last photograph, the pilot's main chute is deployed, but not opened. Pilot was traveling slowly enough to land safely without chute.

CAB Accident Investigation Report:

Traffic Control Practices Cited in Collision

At approximately 1430 EST, Sept. 30, 1959, a Cessna 140, N 1652V, owned and flown by Richard G. Hochrein, while on final approach to runway 15 at the North Philadelphia Airport collided with an Aeronca L-16A, N 9330H, owned and operated by Philadelphia Group No. 10, 31st Pennsylvania Wing of the Civil Air Patrol piloted by Robert T. Wilson. The Cessna crashed to the ground, killing the pilot. The pilot of the Aeronca was able to regain control of his damaged aircraft and effect a successful landing.

The Board has determined that this accident was caused by the failure of the Federal Aviation Agency tower personnel to issue timely air traffic control advisories to Cessna N 1652V which would have alerted the pilot to a possible traffic conflict, and the failure of the two pilots to maintain proper vigilance to avoid collision while flying a traffic pattern in preparation for landing.

At approximately 1355[1], Robert T. Wilson, a pilot with the Pennsylvania Wing of the Civil Air Patrol, departed North Philadelphia Airport piloting a silver-painted CAP Aeronca, N 9330H, for a local solo training flight. The Aeronca did not have a radio and, according to Wilson, received a green light from the tower for takeoff. After takeoff, the aircraft departed the field area for approximately 10 to 15 min. It then returned to the North Philadelphia Airport and began making touch-and-go landings utilizing runway 15. Wilson held a valid private pilot certificate and had a total of 600 flying hours.

At approximately 1400, a Cessna 140, N 1652V, painted green trim on cream, owned and piloted by Richard G. Hochrein of Portland, Penn., departed Lake Susquehanna Airport, Blairstown, N. J., for the North Philadelphia Airport. At approximately 1420, the North Philadelphia Airport tower received a radio call from N 1652V requesting landing instructions. The tower cleared the aircraft to enter the landing pattern and to land on runway 15. No traffic information was given to the pilot at this time. Hochrein held a valid private pilot certificate and had accumulated a total of 122 flying hours.

The field elevation of North Philadelphia Airport is 120 ft.; the recommended traffic is left, to be flown at an altitude of 1,000 ft. above the ground.

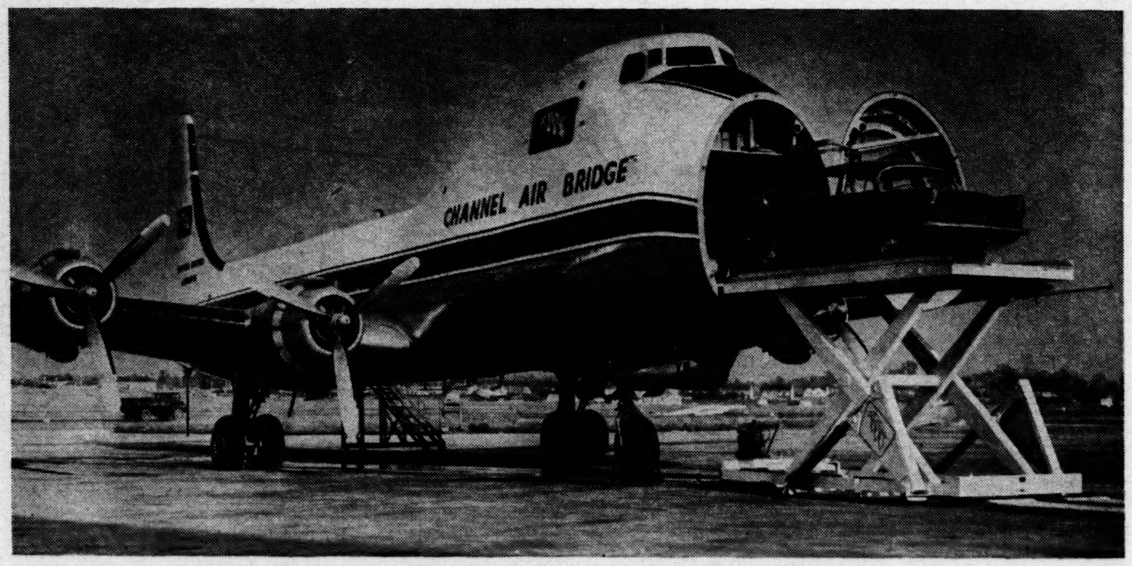
The pilot of the Aeronca said that after returning to the airport he was on his third or four touch-and-go approach to runway 15 and had not received any light signals from the tower since receiving a green light for the original takeoff. Several aeronautically experienced groundwitnesses, who were seated on a bench directly in front of the tower at the time, observed the aircraft making touch-and-go landings. According to these witnesses, both aircraft were observed to be in close proximity to one another while they were on their downwind, base, and final approach. These witnesses place the Aeronca inside of, ahead of, and at approximately the same altitude as the Cessna when observed on the downwind leg.

After clearing the Cessna via radio for landing on runway 15, the tower operator located the aircraft visually on the downwind leg. He also observed another aircraft which he identified as the Aeronca, which, he states, was outside of, above, and behind the Cessna. He did not observe the Aeronca practicing touch-and-go landings prior to this time.

The following testimony was given by the two tower operators on duty: An alternate green and red warning light[2] was given to what they believed to be the Aeronca while it was on the downwind leg and while the aircraft was turning onto the base leg. No instructions or advisories were issued via radio to the Cessna pilot as he traversed the downwind and base leg. The light was changed to steady red[3] which was directed toward the Aeronca until the aircraft collided. No subsequent radio contacts were made with the Cessna pilot, following the initial issuance of landing instructions, until just prior to the collision when the Cessna pilot was told, "Do not land." An exchange of conflicting traffic or reason for cancellation of the original landing clearance was not given to the pilot of the Cessna. The Cessna then acknowledged the message, leveled off, and continued straight ahead.

According to the Aeronca pilot, no lights from the tower were observed by him at any time during this approach, nor during any of his previous approaches and touch-and-go landings. The only light signals transmitted by the tower during his previous touch-and-go landings was the green light for the original takeoff clearance.

The midair collision occurred approximately 500 ft. from the approach end of runway 15 while both aircraft were lined up on their final approach. The Cessna was directly below and a little to the right of the Aeronca. The Aeronca continued to descend after the Cessna leveled off and initial impact occurred between the forward left wingtip of the Cessna and the underside of the Aeronca right aft lift strut midway at the strut brace position. The Cessna proceeded under the Aeronca's wing and the leading edge of the Cessna's vertical stabilizer contacted the Aeronca's right aileron, bending the Cessna's stabilizer and rudder 90 deg. to the right to a flat position. Both aircraft momentarily locked together and entered a bank to the left. The Aeronca managed to turn inside the Cessna and pull up. According to the pilot of the Aeronca, the Cessna then pulled up and struck the Aeronca a second time, this time in the area of the right wing struts. A dent was also made in the underside of the leading edge of the right wing. The Cessna pilot lost control of his aircraft and it plunged to the ground. Collision impact caused binding of the Aeronca's right aileron and subsequent partial loss of control. However, the pilot succeeded in landing on runway 15 with no



Swiss to Receive Carvair Service

Swiss government approved Channel Air Bridge services to Basle and Geneva Nov. 15, using the ATL-98 Carvair, a Douglas DC-4 conversion (AW Sept. 4, p. 46). New service, which also will connect with Strasbourg, will start next April, using Southend Airport as the departure terminal. Company has 10 Carvairs on order. Conversion is being carried out at Southend by Aviation Traders, Ltd. Both firms are subsidiaries of British United Airways, the United Kingdom's largest independent operator.

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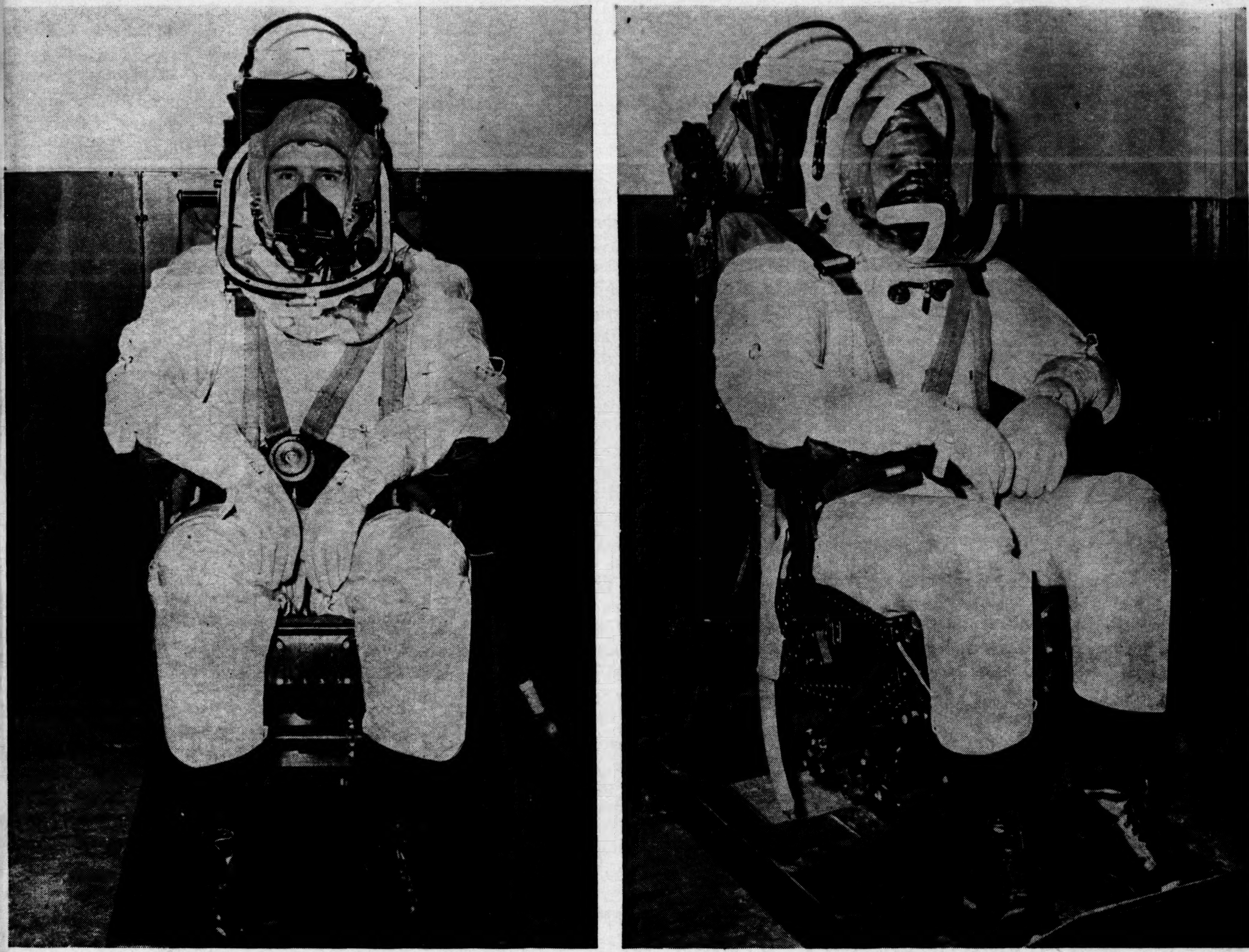
[1] All times herein are eastern standard based on the 24-hour clock.

[2] According to Section 3.221 of the ANC Manual, this light signal used for the control of air traffic means "General warning signal—exercise extreme caution."

[3] This light signal means "Give way to other aircraft and continue circling."



High-Altitude Pressure Suit Developed for RAF Pilots

High altitude full-pressure flying suit for Royal Air Force pilots, newly developed by Royal Aircraft Establishment at Farnborough in collaboration with Siebe Gorman & Co., Ltd., is normally worn in uninflated condition. If cabin pressurization fails, barometric trigger automatically inflates the two tubes at side of helmet, which then snaps shut. Outflow of ventilating air is controlled and suit inflates to pressure sufficient to allow the pilot to stay aloft. Control valve is on pilot's thigh.

further damage. Ground impact of the Cessna occurred 75 ft. from the approach end of runway 15 and 375 ft. to the left of the runway 15 centerline.

Weather at the time was scattered clouds at 4,000 ft., high broken clouds; visibility 15 mi.; temperature 83 F; surface winds from the south-southeast at 13 kts.

A witness driving an auto stopped on a boulevard approximately 2,500 ft. from the end of runway 15 and observed the aircraft pass over his position just prior to the impact. He stated that at this point the Cessna was directly below and to the right of the Aeronca with a vertical separation of approximately 200 ft. All witnesses, including the North Philadelphia Airport tower personnel, agree on that relative position of the two aircraft just prior to impact.

Damaged Areas

The damage sustained by the Aeronca L-16A was confined to the right wing, the right aileron, and the right lift struts. The right aileron had been struck at the trailing edge by the vertical fin of the Cessna. This buckled the diagonal ribs nearest the trailing edge of the aileron, scuffed but did not tear the aileron fabric, and loosened and damaged the internal wing structure forward of the right aileron. No evidence of in-flight contact was found on the tail surfaces, fuselage, or landing gear of the Aeronca.

The in-flight damage to the Cessna was confined to minor damage to the left wing near the tip, and severe damage to the aft fuselage and tail. The left wingtip damage consisted of a tear in the upper fabric and deformation of the internal rib structure. The shape of this damage matched closely with the shape of the aft jury strut bracket attach bolt and nut from the right wing of the Aeronca. The vertical stabilizer was broken at its base and bent approximately 90 deg. to the right and was generally wrinkled; a leading edge dent appeared 18 in. below the tip. The major portion of the left side of the fin had scratches running up and slightly aft. No evidence of in-flight contact between the two aircraft was found on any other part of the Cessna.

The North Philadelphia Airport Control Tower is an FAA tower which operates on a 24-hr. basis. It is staffed by a chief controller and three air traffic control specialists, all of whom had control tower operator certificates with senior ratings. No scheduled air carriers land or take off from North Philadelphia Airport, and traffic consists mostly of light single and twin-engine transient or locally based aircraft. The tower makes no recordings of radio transmissions or receptions.

The tower was equipped with a portable traffic light (Aldis lamp) which is directional and emits an intense, narrow beam of light. The color of the light (white, green, or red) is controlled by the operator through a system of levers and triggers in the two handles. Signals may be discernible to the pilot of any aircraft visible to the tower operators and to which the traffic light is directed.

A small extension from the lamp glows when the light is actuated by a trigger, indicating that the light is operating. The tower controller could not remember whether he saw this indication when he directed the light toward the Aeronca. However, he stated the light did function correctly when checked immediately following the accident.

The disadvantages of the use of the light are that the pilot cannot constantly look at the control tower while flying his airplane and could inadvertently miss a signal directed toward him; the information transmitted by the light signal is limited; and no accurate sighting device is provided.

There was conflicting testimony between the North Philadelphia Control Tower operators and pilots who fly nonradio aircraft as to whether preventive control was in effect at the airport.[4] "Preventive Control" applies at locations which have locally based squadrons or groups of military aircraft, or local civilian operators, or schools such as North Philadelphia Airport. In such cases mutual agreements and arrangements must be made with the responsible heads of these groups prior to the inauguration of preventive control. Such control is not to be employed for transient aircraft.

No evidence could be found to indicate that an agreement or prearrangement had been made in accordance with Section 3.700 of the ANC Manual between the North Philadelphia Airport Control Tower and the Civil Air Patrol, or between the tower and the civilian flying school based at the airport, as related to the use of negative or "preventive control." Nevertheless, several witnesses, including the FAA Supervising Inspector of the Philadelphia General Safety District Office, stated it was the practice at North Philadelphia Airport for nonradio-equipped aircraft to continue an approach and land without light communications. In the absence of radio communications or any light signal, any aircraft may land or take off at any airport without prior approval.

Analysis

Although it is recognized that there was conflicting evidence as to the positions of the aircraft in the traffic pattern, the Board believes that the actual positions of the aircraft were as follows: The Cessna entered the landing pattern behind, to the right of, and below the Aeronca. The Aeronca pilot could not have seen the Cessna without looking back to his right and down. This is quite unlikely since his attention would have most likely been directed to the airport and runway which was to his left as he flew the downwind and base leg.

Considering the relative speeds of the two aircraft, with the Cessna being somewhat faster, the Board believes the two aircraft could maintain this position throughout the traffic pattern until turning onto the final approach. The fact that the Aeronca was on the inside during the turns onto the base and final approach, and therefore traveling the shorter distance, was compensated for by the relatively faster speed of the Cessna. The two 90-deg. turns that each made, served to close the gap between the two aircraft and placed the Cessna under the Aeronca on final approach just prior to collision.

The Aeronca pilot stated that because the air was rougher than usual, he was flying at a slightly higher airspeed which tended to give his aircraft better landing characteristics. When both aircraft were on final approach the tower operator instructed the Cessna pilot by radio not to land. The Cessna pilot acknowledged these instructions and was observed to level off. It was at this point that the collision occurred. Since the Cessna pilot was not told why he was not to land, it can logically be assumed that having received this instruction he leveled the nose of his aircraft and applied power for an aborted landing. The Cessna pilot, having altered his glide angle to level flight and increased his airspeed, overtook and collided with the Aeronca which was descending. The damage to the aileron of the Aeronca and the rudder of the Cessna attests to the fact that the Cessna was moving faster than the Aeronca at the moment of collision.

Light Signal

The tower operator stated an alternating green and red warning light was given the Aeronca pilot while the aircraft was on the downwind leg and while turning on the base leg, and a steady red light was directed toward the Aeronca until the aircraft collided. Whether or not a warning light or a signal to give way or whether such signals were directed to the right aircraft is questionable. The portable traffic lamp was checked immediately after the accident and determined to be in proper working order. It is possible that a warning light was given while both aircraft were on the downwind leg.

With both pilots at this time concentrating on the landing end of the runway and with the tower positioned off to the rear of each pilot's left shoulder, it is reasonable to assume that a light given while the aircraft were in this position could have been missed by both pilots. When both aircraft turned onto base leg, their positions would have enabled their pilots to see the warning light if given, which, according to the tower controller, was meant for the pilot of the Aeronca which he believed was the second aircraft.

Light Apparently Seen

When the two aircraft turned onto fina approach, the possibility of either pilot seeing a light signal from the tower is greatl increased. Yet neither pilot took actio indicative of his having seen a light signa It is reasonable to assume that had th Cessna pilot seen a red warning light shining in his direction, he would have use his radio to inquire whether it was mean for him. Had the Aeronca pilot seen th light he would have discontinued his approach and circled to the left.

It is entirely possible that the reason fo neither pilot seeing a light was because th tower operator directed the light to th second aircraft, which was the Cessna 14 while mistakenly thinking it was the Ae onca L-16. Since the Cessna pilot was re ceiving his instructions by radio, it is un likely that he would be observant of a ligh signal from the tower.

Part 60 of the Civil Air Regulations clear states the responsibility of pilots to o

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[4] The ANC Manual states: "Preventive Control is defined as a system of control whereby useful preventive advice is given to pilots of aircraft in the air and a routine approval of the pilot's anticipated actions is eliminated. . . . The pilot is expected to continue flight including landing in a normal manner unless otherwise advised by the airport traffic controller."

PROBLEMATICAL RECREATIONS 98

Maynard's Grandfather Clock is driven by two weights, one for the striking mechanism which strikes the hours only, the other for the time mechanism. When he hears the clock strike his bedtime, he immediately winds the clock and retires. After winding, the weights are exactly opposite each other. The weights are again opposite every six hours thereafter. What is Maynard's bedtime?
—Contributed

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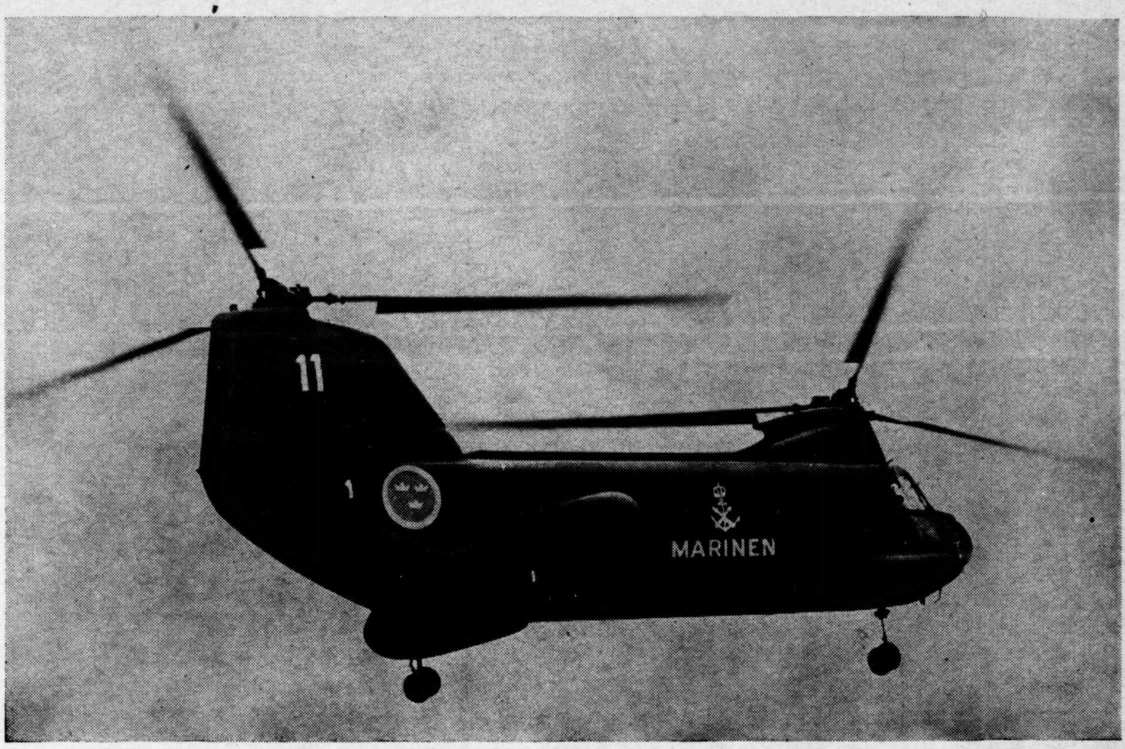

Artist's Conception Shows Swedish V-107

Swedish version of the Boeing-Vertol V-107 twin-turbine helicopter will have 500-gal. external fuel tanks, as shown in this artist's conception. Sweden has ordered six V-107s, designated HKP-4s—two for the navy and four for the air force (AW May 8, p. 28).

serve and avoid other aircraft.[5] Had the Cessna pilot observed the Aeronca L-16 he no doubt would have asked the tower whether there was other traffic in the landing pattern. Had the Aeronca L-16 pilot seen the Cessna 140 he no doubt would have been particularly observant for a light from the tower and would probably have circled to put himself at a farther distance from the Cessna 140. It is evident that had either pilot observed the other aircraft while in the traffic pattern he would have taken some action to ascertain whether the other aircraft was also in the pattern. It is further evident that each pilot continued his landing approach unaware of the presence of the other and without accurate visual or timely verbal warning from the tower until too late to avoid a collision.

Under Part 60 of the Civil Air Regulations, a pilot would be expected to clear his position in preparation for landing, and clear himself in each turn, should he make turns to the base leg and final approach. In the absence of a sequence and on the basis of the clearance received, it was not imprudent of the Cessna pilot to assume that the area was clear of conflicting traffic. Nevertheless, the pilot of the Cessna 140 should have observed the Aeronca L-16 as he entered the downwind leg if he had properly cleared his position as he entered. He should also have observed the Aeronca L-16 as he turned left to the base and final approaches since the Aeronca was inside of him and slightly above his altitude. The entry of the downwind leg at a 45-degree angle for an approach to landing is for the purpose of determining whether other traffic is in the landing pattern and to ensure an orderly entry to traffic, proper spacing for prevention of a collision, and to prevent aircraft from overtaking other aircraft in the traffic pattern.

Part 26 of the Civil Air Regulations prescribed certain procedures and practices which certificated air traffic control tower operators should follow.[6] Part 617.21 of the Administrator's Air Navigation Regulations (14 CFR 617) provided that "an airport traffic control tower is responsible for the issuance of clearances and information to pilots of aircraft for the purpose of protecting air traffic by aiding pilots in the prevention of collision between aircraft . . . in the traffic pattern." Section 60.60 of the Civil Air Regulations defines air traffic control as "a service operated by appropriate authority to promote the safe, orderly, and expeditious flow of air traffic." The duties of the airport traffic controller, therefore, include assisting the person in command of an aircraft by providing such advice and information as may be useful for the safe and efficient conduct of the flight. The failure of the tower controllers to observe the Aeronca L-16 accomplishing touch-and-go landing on runway 15 indicates a neglect of these responsibilities and duties.

The Board believes that the air traffic controllers should have used every means at their disposal, including radio communication, to warn the radio-equipped aircraft of any dangerous situation which might cause a collision. Failure to advise the Cessna 140 pilot by radio while on the downwind and base leg after it appeared that the Aeronca L-16 was not altering course was one of the causal factors in this accident.

The Board concludes that the Cessna 140 pilot, after being cleared by radio, entered the traffic pattern outside of, below and slightly behind the Aeronca L-16 which was already in the traffic pattern accomplishing touch-and-go landings. The Aeronca L-16 was hidden from the view of the Cessna 140 pilot by the left wing of the Cessna, the Cessna being below and to the right rear of the Aeronca. Each pilot continued his landing approach unaware of the presence of the other and without accurate visual or timely verbal warning from the tower until too late to avoid a collision. Visual light indications that were given were mistakenly directed to the Cessna 140 which the tower controller believed was the Aeronca L-16. The Cessna 140 pilot had the best opportunity to observe the Aeronca L-16 as he traversed his 45-degree entry to the downwind leg. He remained behind, slightly below, and to the right of the Aeronca L-16 throughout the remainder of the traffic pattern. The Cessna pilot's failure to observe the Aeronca L-16 was due to either a blind spot caused by a portion of the Cessna blocking out his view of the Aeronca, or his failure to adequately clear himself as he entered the downwing leg, and as he made his left turns to the base leg and final approach. After the Cessna 140 pilot received the warning from the tower not to land during the final approach, he leveled off, overtook the Aeronca L-16 which was descending, and collided with it.

The primary causal factor in this accident was the failure of the North Philadelphia Airport traffic controller to effect accurate visual and timely verbal air traffic advisories to aid the pilots of the aircraft flying the traffic pattern.

The Board determines the probable cause of this accident was the failure of FAA tower personnel to issue accurate visual and timely verbal air traffic advisories and the failure of the pilots of the two aircraft to maintain proper vigilance to avoid collision.

By the Civil Aeronautics Board: Alan S. Boyd, Chairman; Robert T. Murphy, Vice Chairman; G. Joseph Minetti, Member; Whitney Gillilland, Member.

Chan Gurney, Member, did not take part in the adoption of this report.

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[5] "60.12 *Careless or reckless operation.* No person shall operate aircraft in a careless or reckless manner so as to endanger the life or property of others . . .

"(c) Lack of vigilance by the pilot to observe and avoid other air traffic. This includes failure of the pilot to clear his position prior to starting any maneuver, either on the ground or in flight . . ."

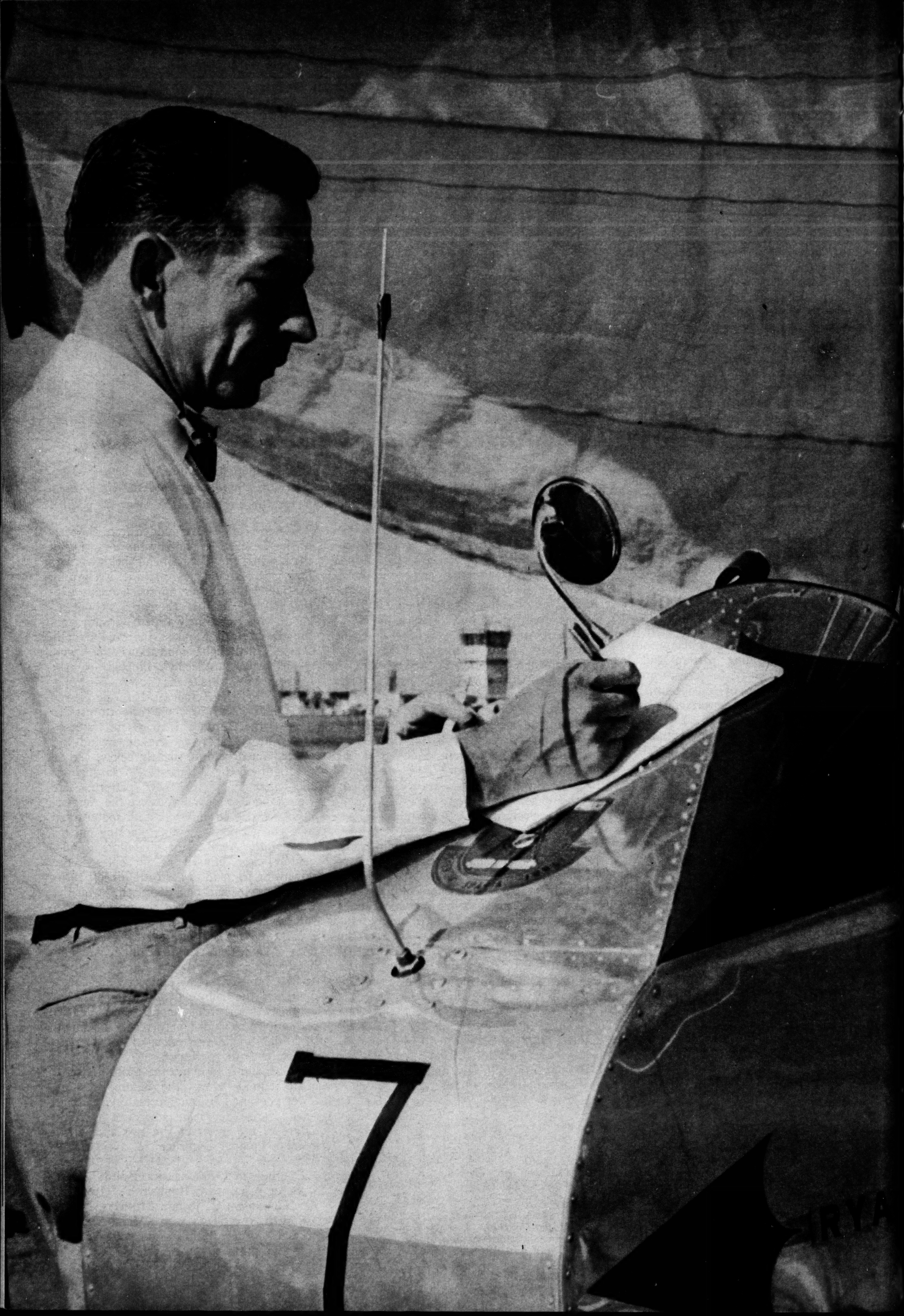
"60.14 (d) *Overtaking.* An aircraft that is being overtaken has the right-of-way, and the overtaking aircraft, whether climbing, descending, or in horizontal flight, shall keep out of the way of the other aircraft by altering its course to the right, and no subsequent change in the relative positions of the two aircraft shall absolve the overtaking aircraft from this obligation until it is entirely past and clear . . ."

"60.14 (e) *Landing.* Aircraft, while on final approach to land, or while landing, have the right-of-way over other aircraft in flight or operating on the surface. When two or more aircraft are approaching an airport for the purpose of landing, the aircraft at the lower altitude has the right-of-way, but it shall not take advantage of this rule to cut in front of another which is on final approach to land, or to overtake that aircraft . . ."

"60.15 *Proximity of aircraft.* No person shall operate an aircraft in such proximity to other aircraft as to create a collision hazard . . ."

[6] "26.26 *Exercise of Authority.* A certificated air-traffic control-tower operator shall control traffic in accordance with the procedures and practices prescribed by the Administrator to provide for the safe, orderly and expeditious flow of air traffic . . ."

Section 60.60 Definitions:
"Air Traffic Control. A service operated by appropriate authority to promote the safe, orderly, and expeditious flow of air traffic."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LETTERS

No Go/No Show

Regarding the recently published agreement by major airlines to impose a $5 to $50 penalty on "no shows," I propose a $50-$500 penalty on "no go" and "late arrive" airlines. Quid pro quo?

Herbert Single
Collingswood, New Jersey

Aviation Week welcomes the opinions of its readers on the issues raised in the magazine's editorial columns. Address letters to the Editor, Aviation Week, 330 W. 42nd St., New York 36, N. Y. Try to keep letters under 500 words and give a genuine identification. We will not print anonymous letters, but names of writers will be withheld on request.

Ejection Seat

Capt. Pyle's letter (AW Nov. 13, p. 138) poses a number of very significant problems that would have to be resolved before an airline could implement Mr. Pritchard's suggestion (AW Oct. 23, p. 136) for placing an ejection seat aboard airliners so that at least one crew member would survive an otherwise all fatal crash.

Unfortunately, however, Capt. Pyle is unaware of some of the realities of airline/union negotiations and the pattern of airline wage scales.

He suggests that the "selected one," i.e., the one that would get the ejection seat would "suffer to compensate for the fringe benefits he receives but may never use?" There is nothing in the history of wage agreements to suggest that the selected one would suffer. Rather, the problem would be (1) would he be given ejection and parachute training at company expense and on company time, and (2) how much additional compensation should he receive because of his therefore increased training and job qualifications? This, then, would open up new problems of "parachute qualified" flight engineers and the Feinsinger Commission, of course, would have to study this. Meanwhile, there would be the question of still additional compensation for crew members not provided with the fringe benefit.

Yes, there would be problems such as those Capt. Pyle suggests, but the world is not so simple that the problems would end there.

(Name withheld by request.)

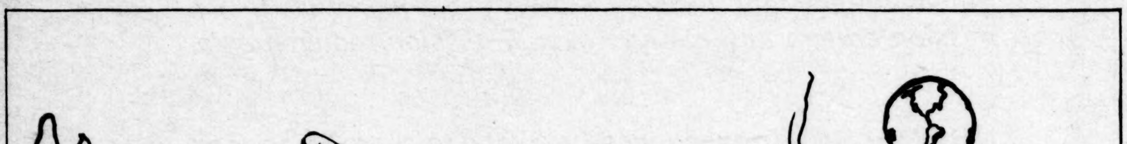
A Bitter Reader
Washington, D. C.

Proposal Abuses

I have just read your editorial in the Oct. 9 issue of Aviation Week and Space Technology ("Toward Genuine Competition"). If anything you have written has ever hit the nail right smack on the thumb, this editorial did. I am an assistant project engineer in a very large firm which does a great deal of proposal work. In my 10 years with the company I have seen costs of proposals grow to equal that of some very worthwhile research efforts. And talk about a "lying contest" and "brochuremanship," well, all I can say is you have either worked in this rat race industry or you are really "plugged in" to a good source of information. Your comments are 100% accurate. Most of us, who are concerned with trying to engineer a good product and also serve our nation, would welcome an end to the present situation. Perhaps Adm. Hayward's efforts and your editorial will help turn the tide. A great many of us really hope so.

J. E. Dinsmor
Whittier, Calif.

P.S. Your editorials usually do hit th thumb! Excellent writing and ideas.



Aha, Comrade, I've found the assembly instructions. It says here, "The knee bone connects to der ankle bone . . ."

——*Contributed by a West Coast engineer.*

Powerplant Designs

In your recent article, "British Weig VTOL Powerplant Designs," (AW Oc 23, p. 77) a report on the Eighth Anglo-American Aeronautical Conference, a representative of Bristol Siddeley is said t have referred to the use of pure lift engine cut off after takeoff as "giving machiner a free ride around the countryside."

Literally, this is true but seems to hav little practical significance.

The Bristol Siddeley people would o course be remiss as campaigners if the didn't exploit an apparent advantage. closer look at the situation, however, indicates that the Bristol Siddeley Pegasu deflected thrust VTOL engine can, on occasion, out do the lift-engine concept i the matter of lugging excess iron about th countryside.

Most high performance VTOL aircra are over burdened with propulsion machinery in one way or another during cruis Some carry inactive, or "cold" machiner as with the lift-engine, or lift-fan type others carry an excess of active machiner operating in a "luke warm," inefficie manner. It does not necessarily follow th the aircraft with the inactive machine has a totally heavier propulsion system.

To make detailed across-the-board comparisons of VTOL propulsion systems difficult at best because to do so is t know all possible applications. Howeve one of the better known VTOL roles, tha of the high subsonic strike-fighter, ma serve here as a point for conjecture.

A casual, back-of-the-envelope analys comparing a 1965 low-level strike-fight employing turbojet lift-engines and hig pressure ratio (compressor) turbofan(s cruise engines with a similar Pegasu powered vehicle of equal gross weight, wi reveal that the lift-engine machine has n greater propulsion system weight and ha greater range with an equal quantity of fue

The Pegasus design is ingenious and ha certain attractive features. But the fact tha it operates as a unit throughout does no necessarily make it more effective as VTOL propulsion system than its contempories with lift-engines, or fans, cu off during cruise.

H. E. Dickard, J
San Diego, Cali